NAS 1.9/4:24/ 20

VOLUME 24 / NUMBER 20
OCTOBER 23, 1986
ACC. NOS. N86-28906 TO N86-29761

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AN ABSTRACT JOURNAL

Scientific and Technical Aerospace Reports

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Scientific and Technical Aerospace Reports, Volume 24, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by RMS Associates.

The Administrator of the National Aeronautics and Space Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through March 22, 1988.

US ISSN 0036-8741

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84 LAW AND POLITICAL SCIENCE **N.A.**
Includes space law; international law; international cooperation; and patent policy.

85 URBAN TECHNOLOGY AND TRANSPORTATION **3254**
Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.
For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

SPACE SCIENCES

Includes space sciences (general); astronomy; astrophysics; lunar and planetary exploration; solar physics; and space radiation.
For related information see also *Geosciences.*

88 SPACE SCIENCES (GENERAL) **N.A.**

89 ASTRONOMY **3255**
Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

90 ASTROPHYSICS **3256**
Includes cosmology; and interstellar and interplanetary gases and dust.

91 LUNAR AND PLANETARY EXPLORATION **3257**
Includes planetology; and manned and unmanned flights.
For spacecraft design see *18 Spacecraft Design, Testing and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

92 SOLAR PHYSICS **3258**
Includes solar activity, solar flares, solar radiation and sunspots.

93 SPACE RADIATION **3259**
Includes cosmic radiation; and inner and outer earth's radiation belts.
For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

GENERAL

99 GENERAL **N.A.**

Note: N.A. means that no abstracts were assigned to this category for this issue.

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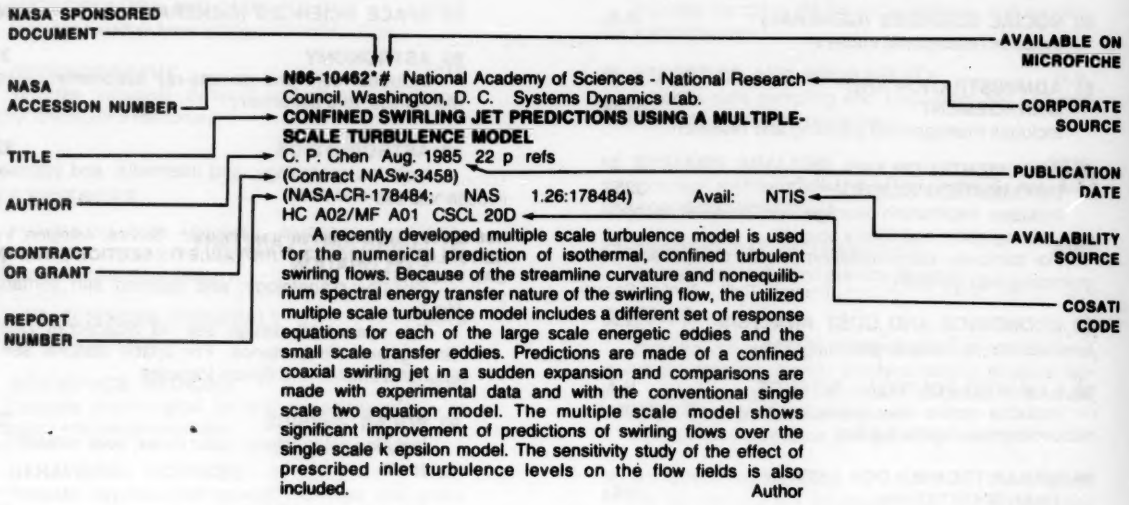
TYPICAL CITATION AND ABSTRACT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NASA ACCESSION NUMBER
N86-10462*# National Academy of Sciences - National Research Council, Washington, D. C. Systems Dynamics Lab.
CORPORATE SOURCE
TITLE
CONFINED SWIRLING JET PREDICTIONS USING A MULTIPLE-SCALE TURBULENCE MODEL
C. P. Chen Aug. 1985 22 p refs
PUBLICATION DATE
AUTHOR
(Contract NASw-3458)
(NASA-CR-178484; NAS 1.26:178484) Avail: NTIS
AVAILABILITY SOURCE
CONTRACT OR GRANT
HC A02/MF A01 CSCL 20D
COSATI CODE
REPORT NUMBER
A recently developed multiple scale turbulence model is used for the numerical prediction of isothermal, confined turbulent swirling flows. Because of the streamline curvature and nonequilibrium spectral energy transfer nature of the swirling flow, the utilized multiple scale turbulence model includes a different set of response equations for each of the large scale energetic eddies and the small scale transfer eddies. Predictions are made of a confined coaxial swirling jet in a sudden expansion and comparisons are made with experimental data and with the conventional single scale two equation model. The multiple scale model shows significant improvement of predictions of swirling flows over the single scale k epsilon model. The sensitivity study of the effect of prescribed inlet turbulence levels on the flow fields is also included.
Author

VOLUME 24 NUMBER 20 / OCTOBER 23, 1986

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N86-28906# Perkin-Elmer Corp., Pomona, Calif. Applied Science Div.
DEVELOPMENT OF A PORTABLE WEAR METAL ANALYZER FOR FIELD USE Final Report, Aug. 1982 - Aug. 1985
William Niu Aug. 1985 115 p
(Contract F33615-81-C-2080)
(AD-A166013; AFWAL-TR-85-2043) Avail: NTIS HC A06/MF A01 CSCL 07/4

The portable wear metal analyzer (PWMA) was developed to perform engine oil analysis when aircraft are deployed away from their home bases. The analyzer can detect nine wear metals in the parts per million concentration ranges. The analyzer uses the graphite furnace atomic absorption technology with a specially developed multi-element analysis scheme. The overall system is packaged into two militarized suitcases, including a nine-channel spectrometer, an air or water-cooled graphite furnace, a miniaturized graphite furnace power supply, a unique sample introduction device, a pneumatic supply system, and microprocessor controlled electronics. The analyzer is simple to set up and use. The operator only needs to introduce an undiluted oil sample, push a start button and wait for the results to be printed out. A brassboard system was first developed followed by six prototypes. Analytical performance as well as environmental compatibility were thoroughly evaluated on the first prototype. Consequently, design improvements were made and incorporated into five subsequent prototypes. Test results of the prototypes indicated that the instruments can meet the oil analysis need in both laboratory and rugged environments. Field tests are under way and the results will further verify the validity of the instruments. GRA

N86-28907# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
[ACTIVITIES REPORT IN AEROSPACE RESEARCH] Annual Report, 1984
24 Apr. 1985 195 p
(ESA-86-97190) Avail: NTIS HC A09/MF A01

Research in aerodynamics; test facilities; spacecraft and aircraft construction materials; spacecraft and aircraft structures; computer science; fluid mechanics; energetics; physics; and aerospace systems is summarized. ESA

N86-28908# Joint Publications Research Service, Arlington, Va.
USSR REPORT: TRANSPORTATION
1 May 1986 61 p Transl. into ENGLISH from various Russian articles
(JPRS-UTR-86-007) Avail: NTIS HC A04/MF A01

General articles from various periodicals are reprinted on transportation in the USSR. Transportation areas are divided generally into civil aviation, motor vehicles and highways, marine and river fleets, and experimental systems. The majority of the articles are on civil aviation. For individual titles, see N86-28909 through N86-28910.

N86-28909# Joint Publications Research Service, Arlington, Va.
AEROFLOT OFFICIALS ROUNDTABLE ON SECTION'S TECHNICAL PROGRESS
S. Sokolov and I. Kazanskiy *In its* USSR Report: Transportation (JPRS-UTR-86-007) 1 May 1986 p 1-9 Transl. into ENGLISH from Grazhdanskaya Aviatsiya (Moscow, USSR), no. 2, Feb. 1986 p 30-33 (For primary document see N86-28908 20-01)
Avail: NTIS HC A04/MF A01

A roundtable discussion is presented on the resolution of the key task of the 12th five-year plan which is the utmost acceleration of scientific and technical progress and an increase in the role of science and technology in transferring the industry onto the rails of the all around intensification and raising to the efficiency and quality of air transportation. A list and affiliation of the participant in the discussion is given. A verbatim script of the discussion is given. E.R.

N86-28910# Joint Publications Research Service, Arlington, Va.
GENERAL DESIGNER BALABUYEV ON AN-124 RUSLAN FEATURES
Petr Vailyevich Balabuyev and Viktor Ilich Tolmachev *In its* USSR Report: Transportation (JPRS-UTR-86-007) 1 May 1986 p 14-21 Transl. into ENGLISH from Tekhnika-Molodezhi (Moscow, USSR), no. 2, Feb. 1986 p 30-35 (For primary document see N86-28908 20-01)
Avail: NTIS HC A04/MF A01

An interview is presented with the designers of a new cargo aircraft. They state that the appearance of the An-22 (Antey) winged heavyweight, capable of carrying 80 tons of different cargo, became a sensation 20 years ago. Created on the same drawing board as the Antey, the Ruslan has a cargo capacity which is almost double that of its older brother 5. It has already scored 21 world records, including carrying a load of 171.2 tons to an altitude of 10, 700 meters. The designers are further questioned about the basic features, advantages, weight reduction, engine type, maintenance, and flight safety. E.R.

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N86-28911*# New York Univ., New York. Courant Mathematics and Computing Lab.
COMPUTATION OF THE TRANSONIC FLOW ABOUT A SWEPT WING IN THE PRESENCE OF AN ENGINE NACELLE Research and Development Report
D. Eoss Dec. 1985 191 p

(Grant NAG2-345; Contract DE-AC02-76ER-03077; Grant NSF DMS-83-20430)
(NASA-CR-177113; NAS 1.26:177113; DOE/ER-03077/267) Avail: NTIS CSCL 01A

A method was developed to model the effects of an engine nacelle on the transonic flow about a swept wing. The nacelle is modeled by adding an inhomogeneous term, which represents a source distribution, to the potential equation, which is solved by relaxation. The method is an extension of the design code FL22INV of Bauer, Garabedian, and McFadden, which was based on Caughy and Jameson's FLO22 and on the oblique wing code FLO16. In order to obtain a sharply defined obstacle using a source distribution on a finite difference grid, a small grid size near the source was used. This was accomplished through a mapping of the flow domain to the computational domain. Once the flow is computed, the size and position of the nacelle are found by tracing streamlines. The effect of the presence of an engine nacelle on the shock waves which form about a swept wing in transonic flight. Author

N86-28912*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
AN ANALYSIS OF BLADE VORTEX INTERACTION AERODYNAMICS AND ACOUSTICS
Duck Joo Lee Sep. 1985 173 p
(Contract NCC2-149)
(NASA-CR-177016; NAS 1.26:177016; SU-JIAA-TR-67) Avail: NTIS HC A08/MF A01 CSCL 01A

The impulsive noise associated with helicopter flight due to Blade-Vortex Interaction, sometimes called blade slap is analyzed especially for the case of a close encounter of the blade-tip vortex with a following blade. Three parts of the phenomena are considered: the tip-vortex structure generated by the rotating blade, the unsteady pressure produced on the following blade during the interaction, and the acoustic radiation due to the unsteady pressure field. To simplify the problem, the analysis was confined to the situation where the vortex is aligned parallel to the blade span in which case the maximum acoustic pressure results. Acoustic radiation due to the interaction is analyzed in space-fixed coordinates and in the time domain with the unsteady pressure on the blade surface as the source of chordwise compact, but spanwise non-compact radiation. Maximum acoustic pressure is related to the vortex core size and Reynolds number which are in turn functions of the blade-tip aerodynamic parameters. Finally noise reduction and performance are considered. Author

N86-28913*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
ANALYTICAL OBSERVATIONS ON THE AERODYNAMICS OF A DELTA WING WITH LEADING EDGE FLAPS
Sejong Oh and Domingo Tavella Mar. 1986 69 p
(Contract NCC2-74)
(NASA-CR-177022; NAS 1.26:177022; SU-JIAA-TR-74) Avail: NTIS HC A04/MF A01 CSCL 01A

The effect of a leading edge flap on the aerodynamics of a low aspect ratio delta wing is studied analytically. The separated flow field about the wing is represented by a simple vortex model composed of a conical straight vortex sheet and a concentrated vortex. The analysis is carried out in the cross flow plane by mapping the wing trace, by means of the Schwarz-Christoffel transformation into the real axis of the transformed plane. Particular attention is given to the influence of the angle of attack and flap deflection angle on lift and drag forces. Both lift and drag decrease with flap deflection, while the lift-to-drag ratioe increases. A simple coordinate transformation is used to obtain a closed form expression for the lift-to-drag ratio as a function of flap deflection. The main effect of leading edge flap deflection is a partial suppression of the separated flow on the leeside of the wing. Qualitative comparison with experiments is presented, showing agreement in the general trends. Author

N86-28914*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
A STUDY OF THE FACTORS AFFECTING BOUNDARY LAYER TWO-DIMENSIONALITY IN WIND TUNNELS
R. D. Mehta and P. H. Hoffmann May 1986 29 p
(Contract NCC2-294)
(NASA-CR-177023; NAS 1.26:177023; SU-JIAA-TR-66) Avail: NTIS HC A03/MF A01 CSCL 01A

The effect of screens, honeycombs, and centrifugal blowers on the two-dimensionality of a boundary layer on the test section floors of low-speed blower tunnels is studied. Surveys of the spanwise variation in surface shear stress in three blower tunnels revealed that the main component responsible for altering the spanwise properties of the test section boundary layer was the last screen, thus confirming previous findings. It was further confirmed that a screen with varying open-area ratio, produced an unstable flow. However, contrary to popular belief, it was also found that for given incoming conditions and a screen free of imperfections, its open-area ratio alone was not enough to describe its performance. The effect of other geometric parameters such as the type of screen, honeycomb, and blower were investigated. In addition, the effect of the order of components in the settling chamber, and of wire Reynolds number were also studied. Author

N86-28915*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
THE LIFT OF SHARP-LEADING-EDGED DELTA WINGS WITH BLOWING
Domingo A. Tavella Dec. 1985 22 p
(Contract NCC2-341)
(NASA-CR-176967; NAS 1.26:176967; JIAA-TR-68) Avail: NTIS HC A02/MF A01 CSCL 01A

An analysis of the lift augmentation due to a thin jet of air issuing from a slot along the leading edge of a delta wing is presented. The problem is treated with an extension of the method of Brown and Michael, representing the separated flow on the lee side of the wing by a pair of concentrated vortices and corresponding feeding sheets. It is assumed that the jet is not affected by Coanda forces. The analysis produces qualitative agreement with experiments. Author

N86-28916*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.
THE USE OF A PANEL CODE ON HIGH LIFT CONFIGURATIONS OF A SWEPT FORWARD WING Final Report, 31 Sep. 1983 - 31 Mar. 1985
James Scott Scheib and Doral R. Sandlin 31 Mar. 1985 70 p
(Contract NCC2-255)
(NASA-CR-176968; NAS 1.26:176968) Avail: NTIS HC A04/MF A01 CSCL 01A

A study was done on high lift configurations of a generic swept forward wing using a panel code prediction method. A survey was done of existing codes available at Ames, frow which the program VSAERO was chosen. The results of VSAERO were compared with data obtained from the Ames 7- by 10-foot wind tunnel. The results of the comparison in lift were good (within 3.5%). The comparison of the pressure coefficients was also good. The pitching moment coefficients obtained by VSAERO were not in good agreement with experiment. VSAERO's ability to predict drag is questionable and cannot be counted on for accurate trends. Further studies were done on the effects of a leading edge glove, canards, leading edge sweeps and various wing twists on spanwise loading and trim lift with encouraging results. An unsuccessful attempt was made to model spanwise blowing and boundary layer control on the trailing edge flap. The potential results of VSAERO were compared with experimental data of flap deflections with boundary layer control to check the first order effects. Author

N86-28917*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.
IDENTIFICATION OF LINEARIZED EQUATIONS OF MOTION FOR THE FIXED WING CONFIGURATION OF THE ROTOR SYSTEMS RESEARCH AIRCRAFT Final Report, 19 Mar. 1985 - 19 Mar. 1986
Dwight L. Balough and Doral R. Sandlin Mar. 1986 98 p
(Contract NCC2-258)

(NASA-CR-176977; NAS 1.26:176977) Avail: NTIS HC A05/MF A01 CSCL 01A

The purpose of this report is to establish linear, decoupled models of rigid body motion for the fixed wing configuration of the Rotor Systems Research Aircraft (RSRA). Longitudinal and lateral control surface fixed linear models were created from aircraft time histories using current system identification techniques. Models were obtained from computer simulation at 160 KCAS and 200 KCAS, and from flight data at 160 KCAS. Comparisons were performed to examine modeling accuracy, variation of dynamics with airspeed and correlation of simulation and flight data results. The results showed that the longitudinal and lateral linear models accurately predicted RSRA dynamics. The flight data results showed that no significant handling qualities problems were present in the RSRA fixed wing aircraft at the flight speed tested. Author

N86-28918*# Kansas Univ. Center for Research, Inc., Lawrence.
WAKE SHAPE AND ITS EFFECTS ON AERODYNAMIC CHARACTERISTICS
Homayoun Emdad and C. Edward Lan Hampton, Va. NASA Jul. 1986 116 p
(Grant NAG1-134)
(NASA-CR-178118; NAS 1.26:178118) Avail: NTIS HC A06/MF A01 CSCL 01A

The wake shape under symmetrical flight conditions and its effects on aerodynamic characteristics are examined. In addition, the effect of wake shape in sideslip and discrete vortices such as strake or forebody vortex on lateral characteristics is presented. The present numerical method for airplane configurations, which is based on discretization of the vortex sheet into vortex segments, verified the symmetrical and asymmetrical roll-up process of the trailing vortices. Also, the effect of wing wake on tail planes is calculated. It is concluded that at high lift the assumption of flat wake for longitudinal and lateral-directional characteristics should be reexamined. Author

N86-28919*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.
A COMPARISON OF COMPUTER-GENERATED LIFT AND DRAG POLARS FOR A WORTMANN AIRFOIL TO FLIGHT AND WIND TUNNEL RESULTS Final Report
Albion Hideto Bowers and Doral R. Sandlin Jun. 1984 46 p
(NASA-CR-176963; NAS 1.26:176963) Avail: NTIS HC A03/MF A01 CSCL 01A

Computations of drag polars for a low-speed Wortmann sailplane airfoil are compared to both wind tunnel and flight results. Excellent correlation is shown to exist between computations and flight results except when separated flow regimes were encountered. Wind tunnel transition locations are shown to agree with computed predictions. Smoothness of the input coordinates to the PROFILE airfoil analysis computer program was found to be essential to obtain accurate comparisons of drag polars or transition location to either the flight or wind tunnel results. Author

N86-28920*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.
COMPARISON OF THEORETICAL AND FLIGHT-MEASURED LOCAL FLOW AERODYNAMICS FOR A LOW-ASPECT-RATIO FIN Final Report, 31 Oct. 1980 - 31 Oct. 1984
J. Blair Johnson and Doral R. Sandlin Oct. 1984 30 p
(Contract NCC4-1)
(NASA-CR-176995; NAS 1.26:176995) Avail: NTIS HC A03/MF A01 CSCL 01A

Flight test and theoretical aerodynamic data were obtained for a flight test fixture mounted on the underside of an F-104G aircraft. The theoretical data were generated using two codes, a two dimensional transonic code called Code H, and a three dimensional subsonic and supersonic code call wing-body. Pressure distributions generated by the codes for the flight test fixture as well as boundary layer displacement thickness generated by the two dimensional code were compared to the flight test data. The two dimensional code pressure distributions compared well except at the minimum pressure point and trailing edge. Shock locations compared well except at high transonic speeds. The three dimensional code pressure distributions compared well except at the trailing edge of the flight test fixture. The two dimensional code does not predict displacement thickness of the flight test fixture well. Author

N86-28921*# Ohio State Univ., Columbus. Dept. of Aeronautical and Astronautical Engineering.
EXPERIMENTAL ANALYSES OF TRAILING EDGE FLOWS Final Technical Report
S. L. Petrie and D. S. Emmer Jun. 1984 96 p
(Grant NsG-2298)
(NASA-CR-176904; NAS 1.26:176904) Avail: NTIS HC A05/MF A01 CSCL 01A

An experimental study of several of the trailing edge and wake turbulence properties for a NACA 64A010 airfoil section was completed. The experiment was conducted at the Ohio State University Aeronautical and Astronautical Research Laboratory in the 6 inch X 22 inch transonic wind tunnel facility. The data were obtained at a free stream Mach number of 0.80 and a flow Reynolds number (based on chord length) of 5 million. The principle diagnostic tool was a dual-component laser Doppler velocimeter. The experimental data included surface static pressures, chordwise and vertical mean velocities, RMS turbulence intensities, local flow angles, and a determination of turbulence kinetic energy in the wake. Two angles of attack (0 and 2 degrees) were investigated. At these incidence angles, four flow field surveys were obtained ranging in position from the surface of the airfoil, between the transonic shock and the trailing edge, to the far-wake. At both angles of attack, the turbulence intensities and turbulence kinetic energy were observed to decay in the streamwise direction. In the far wake, for the non-lifting case, the turbulence intensities were nearly isotropic. For the two degree case, the horizontal component of the turbulence intensity was observed to be substantially higher than the vertical component. Author

N86-28922*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
MEASUREMENTS ON WING-TIP BLOWING
D. Tavella, N. Wood, and P. Harrits Jun. 1985 41 p
(Contract NCC2-271)
(NASA-CR-176930; NAS 1.26:176930; JIAA-TR-64) Avail: NTIS HC A03/MF A01 CSCL 01A

The aerodynamics of a rectangular wing with a jet exhausting in the spanwise direction from the tips has been explored experimentally. By effectively changing the span of the wing as well as outwardly displacing the tip vortices, such jets can induce aerodynamic forces that could be used for roll and lateral control of aircraft. The concept has been investigated for a variety of jet intensities, angles of attack, and aspect ratios. The results appear to confirm theoretically predicted scaling laws for lift gain and moment generation due to blowing. Author

N86-28923*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
A THEORY FOR LATERAL WING-TIP BLOWING
D. Tavella and L. Roberts Jun. 1985 40 p
(Contract NCC2-271)
(NASA-CR-176931; NAS 1.26:176931; JIAA-TR-60) Avail: NTIS HC A03/MF A01 CSCL 01A

The concept of lateral blowing consists in utilizing thin jets of air, which are ejected in the spanwise direction from slots at the tips of straight and swept wings, or along the leading edges of delta wings, to generate aerodynamic forces without the assistance of deflecting solid surfaces. For weak intensities of blowing the so-generated forces could be used for roll and lateral control of aircraft. In this work a theory for this concept as applied to straight wings is presented, revealing the analytical relationship between blowing and aerodynamic forces. The approach is based on perturbing the span of an elliptically loaded wing. Scaling laws involving blowing intensity, aspect ratio, and angle of attack are derived and compared with experiments. It is concluded that this

concept has potential as a novel roll and lateral control device. Author

N86-28924*# Waterloo Univ. (Ontario). Dept. of Applied Mathematics.
CRITICAL EVALUATION OF THE UNSTEADY AERODYNAMICS APPROACH TO DYNAMIC STABILITY AT HIGH ANGLES OF ATTACK Final Report
W. H. Hui Feb. 1985 46 p
(Grant NAGw-575)
(NASA-CR-177104; NAS 1.26:177104; WRI-Pro-308-07) Avail: NTIS HC A03/MF A01 CSCL 01A

Bifurcation theory is used to analyze the nonlinear dynamic stability characteristics of an aircraft subject to single-degree-of-freedom. The requisite moment of the aerodynamic forces in the equations of motion is shown to be representable in a form equivalent to the response to finite amplitude oscillations. It is shown how this information can be deduced from the case of infinitesimal-amplitude oscillations. The bifurcation theory analysis reveals that when the bifurcation parameter is increased beyond a critical value at which the aerodynamic damping vanishes, new solutions representing finite amplitude periodic motions bifurcate from the previously stable steady motion. The sign of a simple criterion, cast in terms of aerodynamic properties, determines whether the bifurcating solutions are stable or unstable. For the pitching motion of flat-plate airfoils flying at supersonic/hypersonic speed and for oscillation of flaps at transonic speed, the bifurcation is subcritical, implying either the exchanges of stability between steady and periodic motion are accompanied by hysteresis phenomena, or that potentially large aperiodic departures from steady motion may develop. Author

N86-28925*# National Aeronautics and Space Administration, Washington, D.C.
AERODYNAMICS OF THE VIGGEN 37 AIRCRAFT. PART 1: GENERAL CHARACTERISTICS AT LOW SPEED
Krister Karling Jun. 1986 145 p Transl. into ENGLISH of the book "Flygplan 37:s Aerodynamik - Part 1: Allmaent egenskaper vid Laaga Farter" Linkoeping, Sweden, SAAB-Scania, 1975 96 p Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88403; NAS 1.15:88403) Avail: NTIS HC A07/MF A01 CSCL 01A

A description of the aerodynamics of the Viggen 37 and its performances, especially at low speeds is presented. The aerodynamic requirements for the design of the Viggen 37 aircraft are given, including the basic design, performance requirement, and aerodynamic characteristics, static and dynamic load test results and flight test results. The Viggen 37 aircraft is designed to be used for air attack, surveillance, pursuit, and training applications. It is shown that this aircraft is suitable for short runways, and has good maneuvering, acceleration, and climbing characteristics. The design objectives for this aircraft were met by utilizing the effect produced by the interference between two triangular wings, positioned in tandem. Author

N86-28926# Oregon State Univ., Corvallis. Dept. of Mechanical Engineering.
FIRST ORDER ANALYSIS OF THE EFFECT OF PITCHING ON THE DRAG COEFFICIENT
R. E. Wilson and J. A. Neff Nov. 1985 39 p
(Contract DE-AC04-76DP-00789)
(DE86-006324; SAND-85-7003) Avail: NTIS HC A03/MF A01

A first order analysis was made for the drag coefficient of a pitching NACA 0015 airfoil below stall. The inviscid velocity ditribution for a translating NACA 0015 airfoil was superimposed with the additional circulation velocity for a pitching ellipse. The resulting velocity distribution was used to numerically integrate a momentum/boundary layer formulation to obtain the drag coefficient. For both laminar and turbulent boundary layers it was found that the effect of pitching on the drag coefficient can be approximated by a shift in angle of attack. The shift angle was found to be a linear function of the pitching velocity and to be less than the induced angle of attack caused by the pitching. DOE

N86-28927# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Dir. Scientifique de la Resistance des Structures.
EXTENSION OF A TRANSONIC THREE-DIMENSIONAL UNSTEADY SMALL PERTURBATION COMPUTING METHOD Final Report [DEVELOPPEMENT DU CODE DE CALCUL DE PETITES PERTURBATIONS TRANSSONIQUES INSTATIONNAIRES EN TRIDIMENSIONNEL]
P. Mulak Aug. 1985 37 p In FRENCH
(Contract DRET-84-34-001)
(ONERA-RTS-23/3064-RY-048-R; ESA-86-97199) Avail: NTIS HC A03/MF A01

A method used for rigid models in unsteady flow is extended to a flexible model to compute the vibration modes. A flexible supercritical wing profile model, that of the A-310 aircraft, was tested in a wind tunnel and the results were compared to computation. The results are in good agreement, but differences with other computing methods for the first four symmetric vibration modes are discussed. ESA

N86-28928# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics and Informatics Div.
DESIGN OF TRANSONIC AIRFOILS WITH GIVEN PRESSURE, SUBJECT TO GEOMETRIC CONSTRAINTS
J. M. J. Fray, J. W. Slooff, J. W. Boerstoel, and A. Kassies 13 Jul. 1984 36 p
(NLR-TR-84064-U; B8660349; ESA-86-97504) Avail: NTIS HC A03/MF A01

An iterative method for the design of airfoils having a prescribed pressure distribution in subsonic or transonic flow is described. In each iteration step, the difference between the current and a target pressure distributions (residual) is determined by a multigrid finite volume full-potential code. Corrections to the geometry driving the pressure residual to zero are determined by a global, inverse, thin-airfoil theory for the subsonic part of the flow field, and by a local, inverse, wavy-wall theory for the supersonic part. The geometry correction is formulated as a minimization problem in the sense that pressure distribution and geometry requirements may be balanced in a weighted least squares sense. ESA

03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N86-28929# National Transportation Safety Board, Washington, D. C.
ANNUAL REVIEW OF AIRCRAFT ACCIDENT DATA. US AIR CARRIER OPERATIONS: CALENDAR YEAR 1982
1982 111 p
(PB86-212529; NTSB-ARC-86-01) Avail: NTIS HC A06/MF A01

The record of aviation accidents involving revenue operations of U.S. Air Carriers are presented, including Commuter Air Carriers and On Demand Air Taxis for calender year 1982. In 1979 and prior years, accidents involving the smaller aircraft used by Commuters and On Demand Air Taxis were reported in annual reviews of general aviation accidents. Three major sections are presented according to the federal regulations under which the flight was conducted: 14 CFR 121, 125, 127, Scheduled 14 CFR 135. In each section, tables are presented to describe the losses and characteristics of 1982 accidents to enable comparison with pior years. Author

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Spacecraft Communications, Command, and Tracking* and *32 Communications.*

N86-28930# IIT Research Inst., Annapolis, Md.
A COMPARISON OF THE EFFECTS OF TWO TRAFFIC ALERT AND COLLISION AVOIDANCE SYSTEMS (TCAS 3 AND TCAS 2) ON THE PERFORMANCE OF THE AIR TRAFFIC CONTROL RADAR BEACON SYSTEM Final Report, May 1984 - Mar. 1986
T. OGrady, D. Katz, and C. Corse Apr. 1986 44 p
(Contract F19628-85-C-0071)
(DOT/FAA/PM-86/8; ECAC-CR-86-027) Avail: NTIS HC A04/MF A01

An analysis was performed to predict the effects of the Traffic Alert and Collision Avoidance System (TCAS 3) on the performance of the Air Traffic Control Radar Beacon System (ATCRBS) in the Los Angeles Basin. This was accomplished by comparing the effects of TCAS 3 and TCAS 2 operations on airborne transponder and ground-based ATCRBS interrogator performance in the same hypothetical peak Los Angeles Basin aircraft deployment. Author

N86-28931*# Analytical Mechanics Associates, Inc., Mountain View, Calif.
EVALUATION OF THE USEFULNESS OF VARIOUS SIMULATION TECHNOLOGY OPTIONS FOR TERPS ENHANCEMENT
A. V. Phatak and J. A. Sorensen May 1986 33 p
(Contract NAS2-11973)
(NASA-CR-177408; NAS 1.26:177408; FAA/PM-86/15; AMA-86-2-II) Avail: NTIS HC A03/MF A01 CSCL 17G

Current approved terminal instrument procedures (TERPS) do not permit the full exploitation of the helicopter's unique flying characteristics. Enhanced TERPS need to be developed for a host of non-standard landing sites and navigation aids. Precision navigation systems such as microwave landing systems (MLS) and the Global Positioning System (GPS) open the possibility of curved paths, steep glide slopes, and decelerating helicopter approaches. This study evaluated the feasibility, benefits, and liabilities of using helicopter cockpit simulators in place of flight testing to develop enhanced TERPS criteria for non-standard flight profiles and navigation equipment. Near-term (2 to 5 year) requirements for conducting simulator studies to verify that they produce suitable data comparable to that obtained from previous flight tests are discussed. The long-term (5 to 10 year) research and development requirements to provide necessary modeling for continued simulator-based testing to develop enhanced TERPS criteria are also outlined. Author

N86-28932# Ohio Univ., Athens. Dept. of Electrical and Computer Engineering.
INVESTIGATIONS FOR IMPROVING OPERATIONAL RELIABILITY AND MAINTAINABILITY OF ILS COMPONENTS. VOLUME 2: FIGURES AND ILLUSTRATIONS Final Report, Feb. 1983 - Feb. 1986
R. H. McFarland, W. D. Phipps, L. D. Brady, Jeff Dennis, and J. D. Longworth Feb. 1986 376 p
(Contract DTFA01-83-C-20025)
(FAA/PM-86/7.11-Vol-2; OU/AEC/EER-79-1-Vol-2) Avail: NTIS HC A17/MF A01

Evaluations and performance analysis of the Instrument Landing System (ILS) are presented for Dallas-Fort Worth, Tex.; Wheeling, W.V.; Bristol, Tenn.; Parkersburg, W.V.; Pontiac, Mich.; and DeKalb-Peachtree, Ga. An investigation of anomalous performance of the glide slope at Lambert-St. Louis is reported. An analysis of Instrument Landing System (ILS) Reference Datum Heights (RDH) is reported, as well as the results of an investigation of glide slope critical areas. A study into the feasibility of developing ground-based checking techniques for validating the Sideband Reference (SBR) glide slope is presented, as well as an assessment of the current standards and tolerances used to qualify glide slope structures. In addition, a proposed methodology for mathematical model validation is discussed. Author

N86-28933*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
DESIGN CONSIDERATIONS FOR FLIGHT TEST OF A FAULT INFERRING NONLINEAR DETECTION SYSTEM ALGORITHM FOR AVIONICS SENSORS
A. K. Caglayan (Charles River Analytics, Inc., Cambridge, Mass.), P. M. Godiwala, and F. R. Morrell Aug. 1986 11 p Presented at the Guidance, Navigation, and Control Conference, Williamsburg, Va., 18-20 Aug. 1986
(NASA-TM-88998; NAS 1.15:88998) Avail: NTIS HC A02/MF A01 CSCL 01D

The modifications to the design of a fault inferring nonlinear detection system (FINDS) algorithm to accommodate flight computer constraints and the resulting impact on the algorithm performance are summarized. An overview of the flight data-driven FINDS algorithm is presented. This is followed by a brief analysis of the effects of modifications to the algorithm on program size and execution speed. Significant improvements in estimation performance for the aircraft states and normal operating sensor biases, which have resulted from improved noise design parameters and a new steady-state wind model, are documented. The aircraft state and sensor bias estimation performances of the algorithm's extended Kalman filter are presented as a function of update frequency of the piecewise constant filter gains. The results of a new detection system strategy and failure detection performance, as a function of gain update frequency, are also presented. Author

N86-28934# Oak Ridge National Lab., Tenn.
CONCURRENT ALGORITHMS FOR AUTONOMOUS ROBOT NAVIGATION IN AN UNEXPLORED TERRAIN
S. V. N. Rao, S. S. Iyengar, C. C. Jorgensen, and C. R. Weisbin 1986 23 p Presented at the IEEE International Conference on Robotics and Automation, San Francisco, Calif., 14 Apr. 1986 Prepared in cooperation with Louisiana State Univ., Baton Rouge
(Contract DE-AC05-84OR-21400)
(DE86-006089; CONF-860434-5) Avail: NTIS HC A02/MF A01

Navigation planning is one of the vital aspects of any autonomous mobile robot. In this paper, we present concurrent algorithms for an autonomous robot navigation system that does not require a pre-learned obstacle terrain model. The terrain model is gradually built by integrating the information from multiple journeys. The available information is used to the maximum extent in navigation planning, and global optimality is gradually achieved. It is shown that these concurrent algorithms are free from deadlocks and starvation. The performance of the concurrent algorithms is analyzed in terms of the planning time, travel time, scanning time, and update time. A modified adjacency list is proposed as the data structure for the spatial graph that represents an obstacle terrain. The time complexities of various algorithms that access, maintain, and update the spatial graph are estimated, and the effectiveness of the implementation is illustrated. DOE

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics.*

N86-28935*# Massachusetts Inst. of Tech., Cambridge.
FORMAL OPTIMIZATION OF HOVERING PERFORMANCE USING FREE WAKE LIFTING SURFACE THEORY
Song-Young Chung Feb. 1986 260 p
(Grant NAG2-275)

(NASA-CR-177103; NAS 1.26:177103) Avail: NTIS HC A12/MF A01 CSCL 01C

Free wake techniques for performance prediction and optimization of hovering rotor are discussed. The influence functions due to vortex ring, vortex cylinder, and source or vortex sheets are presented. The vortex core sizes of rotor wake vortices are calculated and their importance is discussed. Lifting body theory for finite thickness body is developed for pressure calculation, and hence performance prediction of hovering rotors. Numerical optimization technique based on free wake lifting line theory is presented and discussed. It is demonstrated that formal optimization can be used with the implicit and nonlinear objective or cost function such as the performance of hovering rotors as used in this report. Author

N86-28936*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronatuical Engineering.

DEVELOPMENT OF FLIGHT TESTING TECHNIQUES Final Report, 31 Oct. 1979 - 31 Oct. 1984

Doral R. Sandlin Oct. 1984 9 p

(Contract NCC4-1)

(NASA-CR-176996; NAS 1.26:176996) Avail: NTIS HC A02/MF A01 CSCL 01C

A list of students involved in research on flight analysis and development is given along with abstracts of their work. The following is a listing of the titles of each work: Longitudinal stability and control derivatives obtained from flight data of a PA-30 aircraft; Aerodynamic drag reduction tests on a box shaped vehicle; A microprocessor based anti-aliasing filter for a PCM system; Flutter prediction of a wing with active aileron control; Comparison of theoretical and flight measured local flow aerodynamics for a low aspect ratio fin; In flight thrust determination on a real time basis; A comparison of computer generated lift and drag polars for a Wortmann airfoil to flight and wind tunnel results; and Deep stall flight testing of the NASA SGS 1-36. E.R.

N86-28937*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronatuical Engineering.

IN-FLIGHT THRUST DETERMINATION ON A REAL-TIME BASIS Final Report

Ronald J. Ray, Tom Carpenter, and Tom Sandlin Apr. 1984 39 p

(Contract NCC4-1)

(NASA-CR-176997; NAS 1.26:176997) Avail: NTIS HC A03/MF A01 CSCL 01C

A real time computer program was implemented on a F-15 jet fighter to monitor in-flight engine performance of a Digital Electronic Engine Controlled (DEES) F-100 engine. The application of two gas generator methods to calculate in-flight thrust real time is described. A comparison was made between the actual results and those predicted by an engine model simulation. The percent difference between the two methods was compared to the predicted uncertainty based on instrumentation and model uncertainty and agreed closely with the results found during altitude facility testing. Data was obtained from acceleration runs of various altitudes at maximum power settings with and without afterburner. Real time in-flight thrust measurement was a major advancement to flight test productivity and was accomplished with no loss in accuracy over previous post flight methods. Author

N86-28938*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

A ZONAL COMPUTATIONAL PROCEDURE ADAPTED TO THE OPTIMIZATION OF TWO-DIMENSIONAL THRUST AUGMENTOR INLETS

T. S. Lund, D. A. Tavella, and L. Roberts Jul. 1985 148 p

(Contract NCC2-150)

(NASA-CR-176934; NAS 1.26:176934; JIAA-TR-65) Avail: NTIS HC A07/MF A01 CSCL 01C

A viscous-inviscid interaction methodology based on a zonal description of the flowfield is developed as a mean of predicting the performance of two-dimensional thrust augmenting ejectors. An inviscid zone comprising the irrotational flow about the device is patched together with a viscous zone containing the turbulent mixing flow. The inviscid region is computed by a higher order panel method, while an integral method is used for the description of the viscous part. A non-linear, constrained optimization study is undertaken for the design of the inlet region. In this study, the viscous-inviscid analysis is complemented with a boundary layer calculation to account for flow separation from the walls of the inlet region. The thrust-based Reynolds number as well as the free stream velocity are shown to be important parameters in the design of a thrust augmentor inlet. Author

N86-28939*# Boeing Commercial Airplane Co., Seattle, Wash.

DESIGN REQUIREMENTS AND DEVELOPMENT OF AN AIRBORNE DESCENT PATH DEFINITION ALGORITHM FOR TIME NAVIGATION Final Report

K. H. Izumi, J. L. Thompson, J. L. Groce, and R. W. Schwab May 1986 67 p

(Contract NAS1-16300)

(NASA-CR-178037; NAS 1.26:178037) Avail: NTIS HC A04/MF A01 CSCL 17G

The design requirements for a 4D path definition algorithm are described. These requirements were developed for the NASA ATOPS as an extension of the Local Flow Management/Profile Descent algorithm. They specify the processing flow, functional and data architectures, and system input requirements, and recommended the addition of a broad path revision (reinitialization) function capability. The document also summarizes algorithm design enhancements and the implementation status of the algorithm on an in-house PDP-11/70 computer. Finally, the requirements for the pilot-computer interfaces, the lateral path processor, and guidance and steering function are described. Author

N86-28940*# Boeing Commercial Airplane Co., Seattle, Wash.

AN INVESTIGATION OF TNAV EQUIPPED AIRCRAFT IN A SIMULATED EN ROUTE METERING ENVIRONMENT Final Report

J. L. Groce, K. H. Izumi, C. H. Markham, R. W. Schwab, and J. A. Taylor 5 May 1986 98 p

(Contract NAS1-16300)

(NASA-CR-178031; NAS 1.26:178031; D6-52321) Avail: NTIS HC A05/MF A01 CSCL 01C

This document presents the results of an effort to estimate how often a TNAV (Time Navigation) equipped aircraft could be given a TNAV clearance in the En Route Metering (ERM) system as a function of the percentage of arriving traffic which is TNAV equipped. A fast-time simulation of Denver Stapleton international arrival traffic in the Denver Air Route Traffic Control Center route structure, including en route metering operations, was used to develop data on estimated conflicts, clearance communications and fuel usage for traffic mixes of 25, 50, 75 and 100% TNAV equipped. This study supports an overall effort by NASA to assess the benefits and required technology for using TNAV-equipped aircraft in the ERM environment. Author

N86-28941# Societe Nationale des Poudres et Explosifs, Vert-Le-Petit (France).

NEW TRANSPARENT SOLID MATERIAL FOR HELICOPTER WINDSHIELDS Final Report [NOUVEAU MATERIAU MASSIF TRANSPARENT POUR VITRAGE D'HELICOPTERE]

Jacky Pattein 22 Apr. 1985 37 p In FRENCH

(Contract DRET-83-129)

(SNPE-NT-37/85/CRB/NP; ESA-86-97197) Avail: NTIS HC A03/MF A01

Polyurethanes and acrylic-urethane copolymers were studied by experimental casting of large plates. Better properties are obtained by comparison to currently used acrylics, including shock resistance, crazing resistance, thermal behavior, and surface properties. Large problems remain due to mold extraction difficulties, resulting in poor surface appearance. ESA

N86-28942# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Dir. Scientifique de la Resistance des

Structures.

AEROELASTIC TESTS OF OA 206 AND OA 207 PROFILES [ESSAIS AEROELASTIQUES DES PROFILES OA 206 ET OA 207]

B. Peleau May 1985 73 p In FRENCH
(Contract STPA-83-95-013)
(ONERA-RT-22/1841-RY-310-R; ONERA-RT-22/1841-RY-311-G; ESA-86-97201) Avail: NTIS HC A04/MF A01

Helicopter rotor wings were tested in a wind tunnel in order to verify a semiempirical unsteady separation model. Static tests and small amplitude sine vibration tests were carried out. The OA 207 profile was also studied using large amplitude oscillations. The detailed numerical results are presented. The small amplitude data are used to establish the model while the large amplitude data are useful for its validation. ESA

N86-28943# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

AN INTRODUCTORY COURSE ON AIRCRAFT LOADING

J. B. deJonge 1984 105 p Presented at Summer Course, Bandung, Indonesia, 1984
(NLR-MP-84090-U; B8660423; ESA-86-97506) Avail: NTIS HC A06/MF A01

Flight loads on aircraft; the effects of flexibility; and loads in continuous turbulence are introduced. Loads in steady horizontal flight; maneuver loads; gust loads; ground loads; landing loads; taxiing and handling loads; pressurization loads; and acoustic loads are discussed. ESA

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N86-28944# RJO Enterprises, Inc., Lanham, Md.

AIRCRAFT AVIONICS SUITABLE FOR ADVANCED APPROACH APPLICATIONS. VOLUME 1: AIRCRAFT FLEET EQUIPAGE

Stanley Kowalski and Thomas H. Croswell Jul. 1986 111 p
(Contract DTFA01-84-Y-01051)
(DOT/FAA/PM-86/25,1) Avail: NTIS HC A06/MF A01

This report catalogs the aircraft avionics suitable for advanced approach applications. The configuration and model numbers of avionics used in navigation and approaches for landing are provided for 79 different types of aircraft. Aircraft are grouped into five user communities which cover Major Air Carriers, Regional Air Carriers, Executive Jets, General Aviation Aircraft, and IFR Helicopters. Avionics evaluation includes VOR NAVs, ADFs, DMEs, RNAVs, AFCS, weather radar and the associated display instruments. These navigation systems are the most popular units for navigation and landing in todays aircraft. ILS glideslope receivers, marker beacon systems, navigation management systems, vertical navigation systems, and long range navigation systems are not covered. Author

N86-28945*# University of Southern Colorado, Pueblo. School of Applied Science and Engineering Technology.

INVESTIGATION OF AN ADVANCED FAULT TOLERANT INTEGRATED AVIONICS SYSTEM Final Technical Report, Nov. 1983 - Mar. 1986

W. R. Dunn, D. Cottrell, Joel Flanders, Alan Javornik, and Michael Rusovick Mar. 1986 76 p
(Contract NCC2-277)
(NASA-CR-176980; NAS 1.26:176980) Avail: NTIS HC A05/MF A01 CSCL 01D

Presented is an advanced, fault-tolerant multiprocessor avionics architecture as could be employed in an advanced rotorcraft such as LHX. The processor structure is designed to interface with existing digital avionics systems and concepts including the Army Digital Avionics System (ADAS) cockpit/display system, navaid and communications suites, integrated sensing suite, and the Advanced Digital Optical Control System (ADOCS). The report defines mission, maintenance and safety-of-flight reliability goals as might be expected for an operational LHX aircraft. Based on use of a modular, compact (16-bit) microprocessor card family, results of a preliminary study examining simplex, dual and standby-sparing architectures is presented. Given the stated constraints, it is shown that the dual architecture is best suited to meet reliability goals with minimum hardware and software overhead. The report presents hardware and software design considerations for realizing the architecture including redundancy management requirements and techniques as well as verification and validation needs and methods. Author

N86-29080# Joint Publications Research Service, Arlington, Va.

AERITALIA: AVIONICS, OPTOELECTRONICS RESEARCH, ATR 42

Alberto Mondini *In its* Europe Report: Science and Technology (JPRS-EST-86-008) 18 Jun. 1986 p 2-5 Transl. into ENGLISH from Science Duemila (Rome, Italy), no. 4, Apr. 1986 p 30-33
(For primary document see N86-29079 20-31)
Avail: NTIS HC A06/MF A01

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and on-board auxiliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N86-28946*# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

A SUPERSONIC FAN EQUIPPED VARIABLE CYCLE ENGINE FOR A MACH 2.7 SUPERSONIC TRANSPORT Final Report

T. S. Tavares 22 Aug. 1985 107 p
(Grant NAG3-697)
(NASA-CR-177141; NAS 1.26:177141) Avail: NTIS HC A06/MF A01 CSCL 21E

The concept of a variable cycle turbofan engine with an axially supersonic fan stage as powerplant for a Mach 2.7 supersonic transport was evaluated. Quantitative cycle analysis was used to assess the effects of the fan inlet and blading efficiencies on engine performance. Thrust levels predicted by cycle analysis are shown to match the thrust requirements of a representative aircraft. Fan inlet geometry is discussed and it is shown that a fixed geometry conical spike will provide sufficient airflow throughout the operating regime. The supersonic fan considered consists of a single stage comprising a rotor and stator. The concept is similar in principle to a supersonic compressor, but differs by having a stator which removes swirl from the flow without producing a net rise in static pressure. Operating conditions peculiar to the axially supersonic fan are discussed. Geometry of rotor and stator cascades are presented which utilize a supersonic vortex flow distribution. Results of a 2-D CFD flow analysis of these cascades are presented. A simple estimate of passage losses was made using empirical methods. Author

N86-28947*# Teledyne CAE, Toledo, Ohio.

VARIABLE AREA RADIAL TURBINE FABRICATION AND TEST PROGRAM

Casimir Rogo Aug. 1986 91 p
(Contract NAS3-23173; DA Proj. 1L1-61101-AH-45)
(NASA-CR-175091; NAS 1.26:175091; AVSCOM-TR-86-C-13)
Avail: NTIS HC A05/MF A01 CSCL 21E

A variable area radial turbine with a moveable nozzle sidewall was experimentally evaluated. The turbine was designed for an advanced variable capacity gas turbine rotorcraft engine. The turbine has a mass flow rate of 2.27 kg/sec (5.0 lbs/sec), and a

rotor inlet temperature of 1477K (2200 F). Testing was conducted at a reduced inlet temperature, but the aerodynamic parameters and Reynolds numbers were duplicated. Overall performance was obtained for a range of nozzle areas from 50% to 100% of the maximum area. The test program determined the effect on performance of: (1) Moving the hub or shroud sidewall; (2) Sidewall-vane clearance leakage; (3) Vaneless space geometry change; and (4) Nozzle cooling flows. Data were obtained for a range of pressure ratios and speeds and are presented in a number of performance maps. Author

N86-28948# Turbomeca S. A. - Brevets Szydlowski, Bordes (France).
COMPRESSORS STUDY: IMPROVING THE EFFICIENCY OF A HIGH PERFORMANCE MULTISTAGE COMPRESSOR Final Report [ETUDE SUR LES COMPRESSORS: AMELIORATION DES RENDEMENTS DE COMPRESSEURS MULTIETAGES A HAUTES PERFORMANCES]
D. Dehondt Jun. 1985 27 p In FRENCH
(Contract DRET-82-342)
(ESA-86-97192) Avail: NTIS HC A03/MF A01

The effect of prerotation at the inlet of each stage was tested on a two stage axial compressor. The technical specifications are 45000 turns/min, 3.35 Kg of air/sec, and a compression rate of 12. A mechanical and aerodynamic study was performed in order to reduce the Mach number at the inlet of the rotating blades. The results confirm that the introduction of prerotation in the design improves overall compressor efficiency. ESA

N86-28949# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Paris (France).
PREDICTION OF THE STABILITY PERFORMANCE OF A TURBOREACTOR COMBUSTION CHAMBER Final Report [PREDICTION DES PERFORMANCES DE STABILITE D'UNE CHAMBRE DE TURBOREACTEURS]
C. Favreau, Y. Chauveau, and M. Desaulty 1985 41 p In FRENCH
(Contract DRET-83-34-502)
(SNECMA-YKC-3269/85; ESA-86-97196) Avail: NTIS HC A03/MF A01

A theoretical prediction method based on the decomposition of the actual combustion chamber in elementary reaction volumes which are described by a model is investigated. Aerodynamic characterization of the chamber, combustion chemistry models, and carburant distribution in the combustion chamber were studied. An algorithm was developed and experimentally verified. The proposed method leads to prediction models which describe CO pollution, efficiency, and combustion stability for a reasonably low computing cost. ESA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

N86-28950*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
IMPLEMENTATION AND FLIGHT TESTS FOR THE DIGITAL INTEGRATED AUTOMATIC LANDING SYSTEM (DIALS). PART 1: FLIGHT SOFTWARE EQUATIONS, FLIGHT TEST DESCRIPTION AND SELECTED FLIGHT TEST DATA
Richard M. Hueschen Jul. 1986 135 p
(NASA-TM-87632-Pt-1; NAS 1.15:87632-Pt-1) Avail: NTIS HC A07/MF A01 CSCL 01C

Five flight tests of the Digital Automated Landing System (DIALS) were conducted on the Advanced Transport Operating Systems (ATOPS) Transportation Research Vehicle (TSRV) -- a modified Boeing 737 aircraft for advanced controls and displays research. These flight tests were conducted at NASA's Wallops Flight Center using the microwave landing system (MLS) installation on runway 22. This report describes the flight software equations of the DIALS which was designed using modern control theory direct-digital design methods and employed a constant gain Kalman filter. Selected flight test performance data is presented for localizer (runway centerline) capture and track at various intercept angles, for glideslope capture and track of 3, 4.5, and 5 degree glideslopes, for the decrab maneuver, and for the flare maneuver. Data is also presented to illustrate the system performance in the presence of cross, gust, and shear winds. The mean and standard deviation of the peak position errors for localizer capture were, respectively, 24 feet and 26 feet. For mild wind conditions, glideslope and localizer tracking position errors did not exceed, respectively, 5 and 20 feet. For gusty wind conditions (8 to 10 knots), these errors were, respectively, 10 and 30 feet. Ten hands off automatic lands were performed. The standard deviation of the touchdown position and velocity errors from the mean values were, respectively, 244 feet and 0.7 feet/sec. Author

N86-28951*# Kansas Univ. Center for Research, Inc., Lawrence.
INVESTIGATION OF EMPENNAGE BUFFETING
C. Edward Lan, I. G. Lee, and William H. Wentz (Wichita State Univ., Kans.) Jul. 1986 81 p
(Grant NAG2-371)
(NASA-CR-177164; NAS 1.26:177164; CRINC-FRL-714-1) Avail: NTIS HC A05/MF A01 CSCL 01C

Theoretical methods of predicting aircraft buffeting are reviewed. For the buffeting due to leading edge vortex breakdown, a method is developed to convert test data of mean square values of fluctuating normal force to buffeting vortex strength through an unsteady lifting-surface theory and unsteady suction analogy. The resulting buffeting vortex from the leading edge extension of an F-18 configuration is used to generate a fluctuating flow field which produces unsteady pressure distribution on the vertical tails. The root mean square values of root bending moment on the vertical tails are calculated for a rigid configuration. Author

N86-28952*# Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
THE INTEGRATED MANUAL AND AUTOMATIC CONTROL OF COMPLEX FLIGHT SYSTEMS Status Report, Apr. 1985 - Jun. 1986
David K. Schmidt 7 Jul. 1986 27 p
(Grant NAG4-1)
(NASA-CR-177086; NAS 1.26:177086) Avail: NTIS HC A03/MF A01 CSCL 01C

The topics of research in this program include pilot/vehicle analysis techniques, identification of pilot dynamics, and control and display synthesis techniques for optimizing aircraft handling qualities. The project activities are discussed. The current technical activity is directed at extending and validating the active display synthesis procedure, and the pilot/vehicle analysis of the NLR rate-command flight configurations in the landing task. Two papers published by the researchers are attached as appendices. E.R.

N86-28953*# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
MULTIVARIABLE CONTROL OF A FORWARD SWEPT WING AIRCRAFT M.S. Thesis
Wilma W. Quinn Jan. 1986 137 p
(Grant NAG2-297)
(NASA-CR-177112; NAS 1.26:177112; LIDS-TH-1530) Avail: NTIS HC A07/MF A01 CSCL 01C

The impact of independent canard and flaperon control of the longitudinal axis of a generic forward swept wing aircraft is examined. The Linear Quadratic Gaussian (LQG)/Loop Transfer Recovery (LTR) method is used to design three compensators: two single-input-single-output (SISO) systems, one with angle of attack as output and canard as control, the other with pitch attitude as output and canard as control, and a two-input-two-output system with both canard and flaperon controlling both the pitch attitude and angle of attack. The performances of the three systems are compared showing the addition of flaperon control allows the

aircraft to perform in the precision control modes with very little loss of command following accuracy. Author

N86-28954*# Massachusetts Inst. of Tech.; Cambridge. Dept. of Aeronautics and Astronautics.
INDIVIDUAL-BLADE-CONTROL RESEARCH IN THE MIT VTOL TECHNOLOGY LABORATORY 1977-1985 Final Report, Nov. 1977 - Nov. 1985
Norman D. Ham Jun. 1986 40 p
(Grant NsG-2266)
(NASA-CR-177121; NAS 1.26:177121; VTL-TR-196-8) Avail: NTIS HC A03/MF A01 CSCL 01C

A new, advanced system for active control of helicopters and its application to the solution of rotor aerodynamic and aeroelastic problems is described. Each blade is individually controlled in the rotating frame over a wide range of frequencies. Application of the system to gust alleviation, attitude stabilization, vibration alleviation, blade lag damping augmentation, stall flutter suppression, blade flapping stabilization, stall alleviation, and performance enhancement is outlined. The effectiveness of the system in achieving most of these applications is demonstrated by experimental results from wind tunnel tests of a model helicopter rotor with individual blade control. The feasibility of achieving many or all of the applications of individual blade control using the conventional helicopter swash plate is demonstrated, and the necessary control laws are presented. Author

N86-28955*# Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
MULTI-INPUT, MULTI-OUTPUT SYSTEM CONTROL FOR EXPERIMENTAL AIRCRAFT Progress Report
David K. Schmidt and E. L. Duke 13 Dec. 1985 57 p
(Contract NCC2-288)
(NASA-CR-177017; NAS 1.26:177017) Avail: NTIS HC A04/MF A01 CSCL 01C

Two techniques, direct eigenspace assignment (DEA) and explicit model following (EMF), are used initially to synthesize control laws for the longitudinal dynamics model of a Short Takeoff and Landing (STOL) vehicle in the landing configuration. The vehicle model and the flight control design are presented. The two synthesis techniques are briefly discussed and the handling qualities specifications mapped into the algorithm formulations. The control laws resulting from exercising the algorithms are evaluated in terms of achieved performance and robustness. Since the synthesized control laws involve full state feedback, methodologies were implemented for the control laws using output feedback without adversely affecting performance and robustness. Finally, the salient features of the two design techniques are summarized and the areas that require further investigation are suggested. B.G.

N86-28956*# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
MULTIVARIABLE CONTROL OF A TWIN LIFT HELICOPTER SYSTEM USING THE LQG/LTR DESIGN METHODOLOGY
Armando A. Rodriguez and Michael Athans 1986 8 p
(Grant NAG2-297)
(NASA-CR-177025; NAS 1.26:177025; LIDS-P-1551) Avail: NTIS HC A02/MF A01 CSCL 01C

Guidelines for developing a multivariable centralized automatic flight control system (AFCS) for a twin lift helicopter system (TLHS) are presented. Singular value ideas are used to formulate performance and stability robustness specifications. A linear Quadratic Gaussian with Loop Transfer Recovery (LQG/LTR) design is obtained and evaluated. Author

N86-28957*# Florida Atlantic Univ., Boca Raton. Dept. of Mechanical Engineering.
AN EXPERIMENTAL AND ANALYTICAL INVESTIGATION OF ISOLATED ROTOR FLAP-LAG STABILITY IN FORWARD FLIGHT
Gopal H. Gaonker, Michael J. McNulty (Army Research and Technology Labs., Moffett Field, Calif.), and J. Nagabhushan (Indian Inst. of Science, Bangalore) Sep. 1985 31 p Presented at the 11th European Rotorcraft Forum, London, England, 10-13 Sep. 1985
(Contract NCC2-361)
(NASA-CR-177028; NAS 1.26:177028; Paper-66) Avail: NTIS HC A03/MF A01 CSCL 01C

For flap-lag stability of isolated rotors, experimental and analytical investigations are conducted in hover and forward flight on the adequacy of a linear quasisteady aerodynamics theory with dynamic inflow. Forward flight effects on lag regressing mode are emphasized. A soft inplane hingeless rotor with three blades is tested at advance ratios as high as 0.55 and at shaft angles as high as 20 degrees. In combination with lag natural frequencies, collective pitch settings and flap-lag coupling parameters, the data base comprises nearly 1200 test points (damping and frequency) in forward flight and 200 test points in hover. By computerized symbolic manipulations, an analytic model is developed in substall to predict stability margins with mode identification. It also predicts substall and stall regions to help explain the correlation between theory and data. Author

N86-28958*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NONLINEAR CONTROL OF AIRCRAFT
L. R. Hunt (Texas Technological Univ., Lubbock), G. Meyer, and R. Su 1984 10 p
(Grants NAG2-189; NAG2-203; Contract N00014-76-C-1136)
(NASA-TM-89225; NAS 1.15:89225) Avail: NTIS HC A02/MF A01 CSCL 01C

Transformations of nonlinear systems were used to design automatic flight controllers for vertical and short takeoff aircraft. Under the assumption that a nonlinear system can be mapped to a controllable linear system, a method using partial differential equations was constructed to approximate transformations in cases where exact ones cannot be found. An application of the design theory to a rotorcraft, the UH-1H helicopter, was presented. Author

N86-28959*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.
FLUTTER PREDICTION FOR A WING WITH ACTIVE AILERON CONTROL Final Report
Kevin Penning and Doral R. Sandlin Jun. 1983 112 p
(Contract NCC4-1)
(NASA-CR-176994; NAS 1.26:176994) Avail: NTIS HC A06/MF A01 CSCL 01C

A method for predicting the vibrational stability of an aircraft with an analog active aileron flutter suppression system (FSS) is expained. Active aileron refers to the use of an active control system connected to the aileron to damp vibrations. Wing vibrations are sensed by accelerometers and the information is used to deflect the aileron. Aerodynamic force caused by the aileron deflection oppose wing vibrations and effectively add additional damping to the system. Author

N86-28960*# National Aeronautics and Space Administration, Washington, D.C.
OPTICAL TECHNOLOGY FOR FLIGHT CONTROL SYSTEMS
Mitsuyoshi Mayanagi Mar. 1986 29 p Transl. into ENGLISH from Japan Society for Aeronautical and Space Sciences Journal (Japan), v. 32, no. 369, Oct. 1984 p 583-593 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88400; NAS 1.15:88400; ISSN-0021-4663) Avail: NTIS HC A03/MF A01 CSCL 01C

Optical applications to the flight control system including optical data bus, sensors, and transducers are analyzed. Examples of optical data bus include airborne light optical fiber technology (ALOFT), F-5E, YA-7D, MIL-STD-1553 fiber optic data bus and NAL-optic data bus. This NAL-optic data bus is applied to STOL, and its characteristics are stressed. Principles and advantages of optical pulse-digital transducers are discussed. Author

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tube facilities; and engine test blocks.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N86-28961*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

INTERFACE OF THE TRANSPORT SYSTEMS RESEARCH VEHICLE MONOCHROME DISPLAY SYSTEM TO THE DIGITAL AUTONOMOUS TERMINAL ACCESS COMMUNICATION DATA BUS

Wesley C. Easley and John S. Tanguy (PRC Kentron, Inc., Hampton, Va.) May 1986 34 p refs

(NASA-TM-87728; NAS 1.15:87728) Avail: NTIS HC A03/MF A01 CSCL 14B

An upgrade of the transport systems research vehicle (TSRV) experimental flight system retained the original monochrome display system. The original host computer was replaced with a Norden 11/70, a new digital autonomous terminal access communication (DATAC) data bus was installed for data transfer between display system and host, while a new data interface method was required. The new display data interface uses four split phase bipolar (SPBP) serial busses. The DATAC bus uses a shared interface ram (SIR) for intermediate storage of its data transfer. A display interface unit (DIU) was designed and configured to read from and write to the SIR to properly convert the data from parallel to SPBP serial and vice versa. It is found that separation of data for use by each SPBP bus and synchronization of data tranfer throughout the entire experimental flight system are major problems which require solution in DIU design. The techniques used to accomplish these new data interface requirements are described. Author

N86-28962# Royal Aircraft Establishment, Farnborough (England).

A NUMERICAL STUDY OF THE AERODYNAMIC INTERFERENCE OF A MODEL SUPPORT SYSTEM USED IN THE RAE 5 METRE WIND TUNNEL

B. C. Hardy 5 Sep. 1985 30 p

(AD-A165671; RAE-TM-AERO-2046; BR97527; ESA-86-97105) Avail: NTIS HC A03/MF A01

Lift interference effects of under-wing strut guards were studied using panel methods. Unexpected reduction in interference with increase in lift beyond a certain value is accounted for by a sweep dependent, nonlinear lift contribution. The level of agreement between theory and experiment shows that the mutual lift and the displacement effects need to be considered. Further comparisons between the calculation method and experiment are necessary to establish how much of the remaining discrepancy in calculations is due to the shortcomings of the method and how much to uncertainties in the experimental data. ESA

N86-28963# Resource International, Inc., Columbus, Ohio.

MECHANISTIC METHODOLOGY FOR AIRPORT PAVEMENT DESIGN WITH ENGINEERING FABRICS. VOLUME 2: ADVANCED CONCEPTS, VALIDATION AND CRITERIA Final Report

Kamran Majidzadeh, George J. Ilves, and V. R. Kumar 7 May 1986 95 p

(Contract DTFA01-81-C-10043)

(DOT/FAA/PM-84/9,II-Vol-2) Avail: NTIS HC A05/MF A01

This report is Volume 2 of a two volume set dealing with the application of non-woven fabrics to rigid airport pavements to control and/or retard the development of reflection cracking of flexible overlays due to both thermal stresses and load-associated fatigue. This volume describes the development of a new viscoelastic analysis model for the analysis of thermal cracking that utilizes fundamental material properties and does not rely on phenomenological distress functions. The methods developed in this work as well as those presented in Phase 1 (Volume 1), have been validated on one airport and four highway projects. The validation is described in this report and shows that the developed analysis models predict the reflection cracking phenomenon for all projects very well. This report also describes the laboratory evaluation of a fiber-asphalt SAMI layer that shows promise for use in reflection cracking control. Finally, specifications for material properties, testing procedures, and construction methods are presented. Author

N86-28964*# National Aeronautics and Space Administration, Washington, D.C.

TESTS WITH THREE-DIMENSIONAL ADJUSTMENTS IN THE RECTANGULAR WORKING SECTION OF THE FRENCH T2 WIND TUNNEL WITH AN AS 07-TYPE SWEPT-BACK WING MODEL

A. Blanchard, M. J. Payry, and J. F. Breil Jul. 1986 161 p Transl. into ENGLISH of "Essais d'Adaptation Tridimensionnelle de la Veine Rectangulaire de la Soufflerie T2 en Presence d'une Maquette d'Aile en Fleche du Type AS 07" rept. OA-34/3075, DERAT-12/5015-DN ONERA, France, Nov. 1985 p 1-24 Transl. by The Corporate Word, Inc., Pittsburgh, Pa.

(Contract NASw-4006)

(NASA-TM-88442; NAS 1.15:88442; OA-34/3075; DERAT-12/5015-DN) Avail: NTIS HC A08/MF A01 CSCL 14B

The results obtained on the AS 07 wing and the working section walls for three types of configurations are reported. The first, called non-adapted, corresponds to the divergent upper and lower rectilinear walls which compensate for limit layer thickening. It can serve as a basis for complete flow calculations. The second configuration corresponds to wall shapes determined from calculations which tend to minimize interference at the level of the fuselage. Finally, the third configuration, called two-dimensional adaptation, uses the standard method for T2 profile tests. This case was tested to determine the influence of wall shape and error magnitude. These results are not sufficient to validate the three-dimensional adaptation; they must be coordinated with calculations or with unlimited atmosphere tests. Author

N86-28965*# National Aeronautics and Space Administration, Washington, D.C.

PERFORMANCE OF THE HIGH SPEED ANECHOIC WIND TUNNEL AT LYON UNIVERSITY

M. Sunyach, B. Brunel, and G. Comte-Bellot Mar. 1986 23 p Transl. into ENGLISH from Revue d'Acoustique (France), v. 18, no. 73, 1985 15 p Transl. by Scientific Translation Service, Santa Barbara, Calif.

(Contract NASw-4004)

(NASA-TM-88388; NAS 1.15:88388) Avail: NTIS HC A02/MF A01 CSCL 14B

The characteristics of the feed duct, the wind tunnel, and the experiments run in the convergent-divergent anechoic wind tunnel at Lyon University are described. The wind tunnel was designed to eliminate noise from the entrance of air or from flow interactions with the tunnel walls so that noise caused by the flow-test structure interactions can be studied. The channel contains 1 x 1 x 0.2 m glass and metal foil baffles spaced 0.2 m apart. The flow is forced by a 350 kW fan in the primary circuit, and a 110 kW blower in the secondary circuit. The primary circuit features a factor of four throat reductions, followed by a 1.6 reduction before the test section. Upstream and downstream sensors permit monitoring of the anechoic effectiveness of the channel. Other sensors allow modeling of the flow structures in the tunnel. The tunnel was used to examine turbulent boundary layers in flows up to 140 m/sec, tubulence-excited vibrations in walls, and the effects of laminar and turbulent flows on the appearance and locations of noise sources. Author

N86-28966*# National Aeronautics and Space Administration, Washington, D.C.

INSTRUMENTATION IN WIND TUNNELS

K. Takashima Jul. 1986 30 p Transl. into ENGLISH from Journal of the Japan Society for Aeronautical and Space Sciences (Japan), v. 32, no. 363, Apr. 1984 p 194-202 Original language document was announced in IAA as A85-40976 Transl. by The Corporate

Word, Inc., Pittsburgh, Pa.
(Contract NASw-4006)
(NASA-TM-78012; NAS 1.15:78012; ISSN-0021-4663) Avail: NTIS HC A03/MF A01 CSCL 14B

Requirements in designing instrumentation systems and measurements of various physical quantities in wind tunnels are surveyed. Emphasis is given to sensors used for measuring pressure, temperature, and angle, and the measurements of air turbulence and boundary layers. Instrumentation in wind tunnels require accuracy, fast response, diversity and operational simplicity. Measurements of force, pressure, attitude angle, free flow, pressure distribution, and temperature are illustrated by a table, and a block diagram. The LDV (laser Doppler velocimeter) method for measuring air turbulence and flow velocity and measurement of skin friction and flow fields using laser holograms are discussed. The future potential of these techniques is studied. E.R.

N86-28967*# National Aeronautics and Space Administration, Washington, D.C.
ITERATIVE ADAPTION OF THE BIDIMENSIONAL WALL OF THE FRENCH T2 WIND TUNNEL AROUND A C5 AXISYMMETRICAL MODEL: INFINITE VARIATION OF THE MACH NUMBER AT ZERO INCIDENCE AND A TEST AT INCREASED INCIDENCE
J. P. Archambaud, J. B. Dor, M. J. Payry, and L. Lamarche Jun. 1986 48 p Transl. into ENGLISH of rept. OA-35/3075, DERAT-13/5015-DNO ONERA, Toulouse, France, Mar. 1986 p 1-16 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4004)
(NASA-TM-88445; NAS 1.15:88445; OA-35/3075; DERAT-13/5015-DNO) Avail: NTIS HC A03/MF A01 CSCL 14B

The top and bottom two-dimensional walls of the T2 wind tunnel are adapted through an iterative process. The adaptation calculation takes into account the flow three-dimensionally. This method makes it possible to start with any shape of walls. The tests were performed with a C5 axisymmetric model at ambient temperature. Comparisons are made with the results of a true three-dimensional adaptation. Author

N86-28968# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.
WALL SELF ADAPTATION PROCESS AT MACH 1.2 Final Report [PROCESSUS D'AUTOADAPTATION DE PAROIS A.M.=1,2]
Y. Lesant Apr. 1985 32 p In FRENCH
(Contract DRET-84-34-001)
(ONERA-RTS-31/3075-AY-402; ESA-86-97198) Avail: NTIS HC A03/MF A01

A wall adaptation algorithm is described and its performance is verified by numerical simulation. The proposed technique aims to reproduce unbounded velocity field conditions in the vicinity of a model during supersonic wind tunnel tests. A Mach one boundary condition is imposed on the subsonic points of the backward limit of the computation domain. The experimental work leading to the choice of an adaptation process is detailed. Flow deviation near the wall was selected to test convergence. The results of the simulation show that three wall geometries are necessary to obtain complete agreement of confined and unbounded flow. ESA

N86-28969# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany). Inst. fuer Experimentelle Stroemungsmechanik.
THE EFFECT OF A SPLITTER PLATE AS BOUNDARY LAYER REMOVAL SYSTEM IN HALF-MODEL TESTING
Hans Bippes Sep. 1985 29 p
(DFVLR-FB-85-64; ISSN-0171-1342; ESA-86-97454) Avail: NTIS HC A03/MF A01; DFVLR, Cologne, West Germany, DM 10.50

The effect of a splitter plate as boundary layer removal system in half-model testing is investigated. The experiments are performed on a rectangular wing in the range of maximum lift in subsonic flow. Oil flow patterns display the footprints of a complicated three-dimensional secondary flow in the neighborhood of the model to wall junction. This secondary flow leads to a considerable increase of local lift. The data analysis reveals that its intensity depends on the vorticity of the free shear layer separating from the suction side of the wing and the spanwise variation of the circulation, but only slightly on the thickness of the boundary layer on the splitter plate. Comparison with tests without splitter plate shows that under the test conditions investigated the use of the splitter plate is not an effective means for improving the mirror conditions in half-model testing. ESA

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N86-28970*# National Aeronautics and Space Administration, Washington, D.C.
PLANETARY EXPLORATION THROUGH YEAR 2000: AN AUGMENTED PROGRAM. PART TWO OF A REPORT BY THE SOLAR SYSTEM EXPLORATION COMMITTEE OF THE NASA ADVISORY COUNCIL
1986 240 p Original contains color illustrations
(NASA-TM-89235; NAS 1.15:89235) Avail: SOD HC $12.00 as 033-000-00987-9; NTIS MF A01 CSCL 22A

In 1982, the NASA Solar System Exploration Committee (SSEC) published a report on a Core Program of planetary missions, representing the minimum-level program that could be carried out in a cost effective manner, and would yield a continuing return of basic scientific results. This is the second part of the SSEC report, describing missions of the highest scientific merit that lie outside the scope of the previously recommended Core Program because of their cost and technical challenge. These missions include the autonomous operation of a mobile scientific rover on the surface of Mars, the automated collection and return of samples from that planet, the return to Earth of samples from asteroids and comets, projects needed to lay the groundwork for the eventual utilization of near-Earth resources, outer planet missions, observation programs for extra-solar planets, and technological developments essential to make these missions possible. M.G.

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbit and launching dynamics.

No abstracts in this category.

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research Support Facilities (Air).*

N86-28971# Range Commanders Council, White Sands Missile Range, N. Mex. Optical Systems Group.
VIDEO STANDARDS AND FORMATS
Feb. 1986 52 p Supersedes TCG-452-77, AD-A042387
(AD-A165934; RCC/OSG-452-86; TCG-452-77) Avail: NTIS HC A04/MF A01 CSCL 17/2

This standard is intended to clarify or augment existing standards where range applications are unique. Electrical performance standards for standard and high resolution monochrome and for color closed circuit television equipment are referred to in this document. These standards are those adopted by industry

and associated professional groups which are applicable to test range use and are consistent with the rapidly developing state of the art. In addition, engineering considerations and practices used for automatic insertion of data into the video format and consequent retrieval for use are outlined. The purpose of this document is to provide users of standard and high resolution monochrome and standard color closed circuit television equipment with the criteria essential for interchange and compatibility of equipment, tape recordings and live signals. These criteria are intended to apply not only to locally generated signals (that is, signals generated by the camera itself or at a nearby point where control can be exercised over picture quality), but also to ensure compatibility for metric video application, where video tape recorders, video disc recorders and data insertion equipment are used. GRA

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; manned orbital laboratories; reusable vehicles; and space stations.

N86-28972*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE PROCESSING APPLICATIONS ROCKET (SPAR) PROJECT: SPAR 10
R. Poorman, comp. Jun. 1986 92 p
(NASA-TM-86548; NAS 1.15:86548) Avail: NTIS HC A05/MF A01 CSCL 20H

The Space Processing Applications Rocket Project (SPAR) X Final Report contains the compilation of the post-flight reports from each of the Principal Investigators (PIs) on the four selected science payloads, in addition to the engineering report as documented by the Marshall Space Flight Center (MSFC). This combined effort also describes pertinent portions of ground-based research leading to the ultimate selection of the flight sample composition, including design, fabrication and testing, all of which are expected to contribute to an improved comprehension of materials processing in space. The SPAR project was coordinated and managed by MSFC as part of the Microgravity Science and Applications (MSA) program of the Office of Space Science and Applications (OSSA) of NASA Headquarters. This technical memorandum is directed entirely to the payload manifest flown in the tenth of a series of SPAR flights conducted at the White Sands Missile Range (WSMR) and includes the experiments entitled, Containerless Processing Technology, SPAR Experiment 76-20/3; Directional Solidification of Magnetic Composites, SPAR Experiment 76-22/3; Comparative Alloy Solidification, SPAR Experiment 76-36/3; and Foam Copper, SPAR Experiment 77-9/1R. Author

N86-28973*# Martin Marietta Corp., Denver, Colo.
NEAR-FIELD TESTING OF THE 15-METER MODEL OF THE HOOP COLUMN ANTENNA. VOLUME 3: NEAR- AND FAR-FIELD PLOTS FOR THE JPL FEED
John Hoover, Neill Kefauver, Tom Cencich, and Jim Osborn Mar. 1986 147 p
(Contract NAS1-18016)
(NASA-CR-178061; NAS 1.26:178061; MCR-85-640-Vol-3) Avail: NTIS HC A07/MF A01 CSCL 09C

Technical results from near-field testing of the 15-meter model of the hoop column antenna at the Martin Marietta Denver Aerospace facility are discussed. The antenna consists of a deployable central column and a 15 meter hoop, stiffened by cables into a structure with a high tolerance repeatable surface and offset feed location. The surface has been configured to have four offset parabolic apertures, each about 6 meters in diameter, and is made of gold plated molybdenum wire mesh. Pattern measurements were made with feed system radiating at frequencies of 7.73, 11.60, 2.27, 2.225, and 4.26 (all in GHz). This report (Volume 3) gives the detailed patterns measured with the JPL feed (2.225 GHz). Volume 1 covers the testing from an overall viewpoint and contains information of generalized interest for testing large antennas, including the deployment of the antenna in the Martin Facility and the measurements to determine mechanical stability and trueness of the reflector surface, the test program outline, and a synopsis of antenna electromagnetic performance. A detailed listing of the antenna patterns for the LaRC feeds (7.3, 11.60, 2.27, and 4.26 GHz) are given in Volume 2 of this report. Author

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and rescue techniques.

For related information see also *03 Air Transportation and Safety* and *85 Urban Technology and Transportation.*

N86-28974# Presidential Commission on the Space Shuttle Challenger Accident, Washington, D.C.
REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, VOLUME 2
1986 485 p
Avail: SOD HC $40.00 as 040-000-00503-0 in set with volume 3; NTIS MF A01

Volume 2 continues with the findings of the commission regarding the circumstances surrounding the Challenger accident. The report of an independent test team appointed to determine if the tests and analyses being performed by the Marshall Center and Morton Thiokol were adequate to provide the information needed by the panel is given. Some personal observations on the reliability of the shuttle is given by R. P. Feynman. The work schedules of NASA and contractor personnel involved in the launch processing at Kennedy and Marshall Centers are reviewed in terms of human factors analysis. In the flight readiness review treatment of O-ring problems case to case field joint and nozzle to case joint O-ring anomalies experiences in flight and documents are described. NASA's Prelaunch Activities Team, Mission Planning and Operations Team, Development and Production Team, and Accident Analysis Team reports are given. Finally, comments by Morton Thiokol on the NASA reports are presented. E.R.

N86-28975# Presidential Commission on the Space Shuttle Challenger Accident, Washington, D.C.
REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, VOLUME 3
1986 534 p
Avail: SOD HC $40.00 as 040-000-00503-0 in set with volume 2; NTIS MF A01

The report of the NASA Photo and TV Support Team is given. It describes the significant observed anomalies and related events of the STS 51-L accident and includes image enhancement results which were used to identify, locate, and determine time related characteristics of the events. The NASA Search, Recovery, and Reconstruction Task Force Team report is also given. It includes summaries of the surface search, sonar mapping, recovery, structural reconstruction and evaluations and conclusions drawn. E.R.

N86-28976# Presidential Commission on the Space Shuttle Challenger Accident, Washington, D.C.
REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, VOLUME 4
1986 828 p
Avail: SOD HC $47.00 as 040-000-00504-8 in set with volume 5; NTIS MF A01

This volume contains all the hearings of the Presidential Commission on the Space Shuttle Challenger accident from 6 February to 25 February 1986. Among others, the testimony of NASA's acting administrator William R. Graham is included. E.R.

N86-28977# Presidential Commission on the Space Shuttle Challenger Accident, Washington, D.C.
REPORT OF THE PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, VOLUME 5
1986 884 p
Avail: SOD HC $47.00 as 040-000-00504-8 in set with volume 4; NTIS MF A01

This volume contains all the hearings of the Presidential

Commission on the Space Shuttle Challenger accident from 26 February to 2 May 1986. Among others is the testimony of L. Mulloy, Manager, Space Shuttle Solid Rocket Booster Program, Marshall Space Flight Center and G. Hardy, Deputy Director, Science and Engineering, Marshall Space Flight Center. E.R.

N86-28978# Joint Publications Research Service, Arlington, Va.
WEST EUROPE REPORT: SCIENCE AND TECHNOLOGY
12 Jul. 1985 60 p Transl. into ENGLISH from various West European articles
(JPRS-WST-85-021) Avail: NTIS HC A04/MF A01

Topics addressed include: aerospace industry; biotechnology; civil aviation; computers; microelectronics; scientific and industrial policy; and technology transfer. For individual titles, see N86-28979 through N86-28980.

N86-28979# Joint Publications Research Service, Arlington, Va.
EUROPE LOOKS TO TWENTY-FIRST CENTURY WITH HERMES
In its West Europe report: Science and Technology (JPRS-WST-85-021) 12 Jul. 1985 4 p Transl. into ENGLISH from Revue Aerospatiale (Paris, France), Jun. 1985 p 9; 11; 15 (For primary document see N86-28978 20-16)
Avail: NTIS HC A04/MF A01

Hermes, a manned spacecraft launched by Ariane 5, is described. Requirements for composite materials are discussed for use in the structural design. The docking mechanism is designed to be compatible with the US space station, with Columbus, and with the Soviet station. The reentry, approach, and landing are also discussed. B.G.

N86-28980# Joint Publications Research Service, Arlington, Va.
PHILIPS DEVELOPS A NEW KIND OF SEMICONDUCTOR IMAGE SENSOR **c76**
In its West Europe report: Science and Technology (JPSR-WST-85-021) 12 Jul. 1985 2 p Transl. into ENGLISH from Frankfurter Zeitung/Blick Durch die Wirtschaft (Frankfurt-Main, West Germany), 8 May 1985 p 5 (For primary document see N86-28978 20-16)
Avail: NTIS HC A04/MF A01

A semiconductor image sensor which contains twice as many light sensitive elements per surface unit as the sensors currently known is described. The improvement in performance is due to a different method of applying voltages to the electrodes. The distribution and performance of the electrodes are described. The charge transport process is described using a two electrode per cell scheme. B.G.

17 SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications.*

No abstracts in this category.

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes spacecraft thermal and environmental control; and attitude control.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance* and *39 Structural Mechanics.*

N86-28981*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NONLINEAR DYNAMIC ANALYSIS OF DEPLOYING FLEXIBLE SPACE BOOMS
Paul E. McGowan and Jerrold M. Housner Sep. 1985 34 p
(NASA-TM-87617; NAS 1.15:87617) Avail: NTIS HC A03/MF A01 CSCL 22B

A fundamental investigation of the planar deployment and lock-up of two flexible boom type appendages which have attached tip masses and are connected to a central rigid body through a rotational spring is presented. Nondimensional parameters are identified and it is shown that, in general, the solution depends only on two mass ratios and one nondimensional stiffness parameter. Results are presented for boom tip deflections, deployment time and root moments at lock-up. A threshold value of the nondimensional stiffness parameter is identified beyond which boom deflections become large. Also, a thorough examination of the effect of nonlinear terms in the equations governing the deployment phase is performed. Nonlinear terms in the deployment equations due to kinematics and structural deformation are required to predict more accurately boom deflections, but retention of an inconsistent set of nonlinear terms leads to erroneous results. In particular, retaining nonlinear kinematic terms while neglecting nonlinear structural terms can produce inaccurate results even below the threshold stiffness value. Author

N86-28982*# California Univ., Davis. Dept. of Psychology.
IMPLICATIONS OF PRIVACY NEEDS AND INTERPERSONAL DISTANCING MECHANISMS FOR SPACE STATION DESIGN Final Report, 1 Jun. - 31 Dec. 1985
Albert A. Harrison, Robert Sommer, Nancy Struthers, and Kathleen Hoyt 3 Jan. 1986 51 p
(Grant NAG2-357)
(NASA-CR-177097; NAS 1.26:177097) Avail: NTIS HC A04/MF A01 CSCL 22B

The literature on privacy needs, personal space, interpersonal distancing, and crowding is reveiwed with special reference to spaceflight and spaceflight analogous conditions. A quantitative model is proposed for understanding privacy, interpersonal distancing, and performance. The implications for space station design is described. Author

N86-28983*# North Carolina Univ., Charlotte. Dept. of Electrical Engineering.
DYNAMICS AND CONTROL OF FLEXIBLE SPACECRAFT DURING AND AFTER SLEWING MANEUVERS Semiannual Progress Report, 1 Nov. 1985 - 30 Apr. 1986
Yogendra P. Kakad 30 Apr. 1986 25 p
(Grant NAG1-535)
(NASA-CR-177027; NAS 1.26:177027) Avail: NTIS HC A02/MF A01 CSCL 22B

The dynamics and control of slewing maneuvers of a large flexible spacecraft, namely, NASA Spacecraft Control Laboratory Experiment (SCOLE) test article are studied. The dynamical equations obtained for slewing maneuvers are highly nonlinear and coupled. The maneuver is expressed in terms of four Euler parameters and is specified as the angular displacement about an arbitrary axis. The slew maneuver control problem is developed in terms of rigid-body slewing and suppression of two elastic modes is analyzed using the method of nonlinear decoupling. Author

N86-28984*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INTEGRATED THERMAL-STRUCTURAL-ELECTROMAGNETIC DESIGN OPTIMIZATION OF LARGE SPACE ANTENNA REFLECTORS
Howard M. Adelman and Sharon L. Padula Jun. 1986 18 p Presented at the 27th AIAA/ASME/ASCE/AHS Structures, Structural Dynamics and Materials Conference, San Antonio, Tex., 19-21 May 1986
(NASA-TM-87713; NAS 1.15:87713) Avail: NTIS

HC A02/MF A01 CSCL 22B

The requirements for low mass and high electromagnetic (EM) performance in large, flexible space antenna structures in motivating the development of a systematic procedure for antenna design. In contrast to previous work which concentrated on reducing rms distortions of the reflector surface, thereby indirectly increasing antenna performance, the current work involves a direct approach to increasing electromagnetic performance using mathematical optimization. The thermal, structural, and EM analyses are fully integrated in the context of an optimization procedure, and consequently, the interaction of the various responses is accounted for directly and automatically. Preliminary results are presented for sizing cross-sectional areas of a tetrahedral truss reflector. The results indicate potential for this integrated procedure from the standpoint of mass reduction, performance increase, and efficiency of the design process. Author

N86-28985# Control Dynamics Co., Huntsville, Ala.
ASCOT (ADVANCED STRUCTURAL CONTROL TECHNIQUES) Final Report, Nov. 1983 - Jan. 1985
Sherman M. Seltzer, Danny K. Tollison, Thomas G. Howsman, Richard D. Irwin, and William P. Maggard Sep. 1985 164 p
(Contracts F30602-84-C-0012; ARPA Order 4828; DA Proj. D82-8)
(AD-A165917; CDC-223-1284-FR-ASC; RADC-TR-85-166) Avail: NTIS HC A08/MF A01 CSCL 09/2

This is the Control Dynamics Company final technical report on Advanced Structural Control Techniques (ASCOT). Included is the description and application of a novel technique for the design of low order digital controllers for very high order system models. Also included is an investigation of a digital prefiltering technique which incorporates non-uniform rate sampling. GRA

N86-28986# Kayser Threde G.m.b.H., Munich (West Germany). Inst. fuer Plasmaforschung.
ANTHRORACK PHASE A STUDY. VOLUME 1: SYSTEM SPECIFICATION Final Report
W. Bangert, comp. Paris ESA 1 Feb. 1985 71 p Prepared in cooperation with SNIAS, St. Medard-en-Jalles, France, Compagnie Industrielle Radioelectrique, Gals, Switzerland, and Energy Research Laboratory
(Contract ESA-5916/84-F-FL(SC))
(AN-RP-0000-01B-KT-Vol-1; ESA-CR(P)-2111-Vol-1;
ESA-86-96644) Avail: NTIS HC A04/MF A01

Specifications of a Spacelab facility to study human physiology in microgravity are given. Technical risks and uncertainties are summarized. ESA

N86-28987# Kayser Threde G.m.b.H., Munich (West Germany). Inst. fuer Plasmaforschung.
ANTHRORACK PHASE A STUDY. VOLUME 2: PROGRAM PLANNING Final Report
P. Rank, comp. Paris ESA 1 Feb. 1985 175 p Prepared in cooperation with SNIAS, St. Medard-en-Jalles, France, Compagnie Industrielle Radioelectrique, Gals, Switzerland, and Energy Research Laboratory
(Contract ESA-5916/84-F-FL(SC))
(AN-RP-0000-01B-KT-Vol-2; ESA-CR(P)-2111-Vol-2;
ESA-86-96645) Avail: NTIS HC A08/MF A01

A low cost approach to developing a Spacelab facility to study human physiology in microgravity is outlined. ESA

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N86-28988# Centre National d'Etudes Spatiales, Toulouse (France). Div. Transmissions, Instrumentation et Traitement.
THEORETICAL AND EXPERIMENTAL STUDY OF POSEIDON ALTIMETER ACQUISITION PHASE
Pierre Leducq 6 Nov. 1984 49 p In FRENCH; ENGLISH summary
(CNES-337-84/CT/DRT/TIT/RL; ESA-86-97179) Avail: NTIS HC A03/MF A01

The altimeter system is based on a 900 MHz frequency ramp at 13.65 GHz band, the ramp length being 10 micro sec. Heterodyning the signal and the echo gives a frequency proportional to the distance. Pursuit algorithms are used to estimate the altitude. A breadboard model of the hardware was used in the performance tests. The results are in agreement with the theory and the simulations. Acceptable values are obtained at signal to noise ratios of 3 dB. ESA

N86-28989# Centre National d'Etudes Spatiales, Toulouse (France).
TOPEX - POSEIDON CNES SENSORS Final Report
N. Lannelongue, J. P. Aguttes, and P. Raizonville 17 Sep. 1984 25 p
(CNES-CT/DRT/TIT/RL-294-T; ESA-86-97180) Avail: NTIS HC A02/MF A01

A solid state altimeter and a DORIS precision tracking system receiver for the TOPEX satellite were designed. A solid state altimeter sharing the TOPEX antenna was chosen instead of a solid state amplifier for the NASA altimeter. The altimeter will be ON only when the NASA altimeter is OFF and vice-versa. The DORIS receiver will be ON full time during the mission. Attitude specifications; orbit control; altimeter antenna sharing; DORIS TRANET compatibility; interference studies; radiation studies; and definition of the sensor interface are discussed. ESA

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources.

For related information see also *07 Aircraft Propulsion, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N86-28990# Naval Postgraduate School, Monterey, Calif.
DIFFUSION ESTIMATES HANDBOOK (APPLICATION TO THE SPACE SHUTTLE HC1 EXHAUST CLOUD) Report, Oct. 1985 - Feb. 1986
G. E. Schacher, S. Larsen, and T. Mikkelsen Feb. 1986 44 p
(Contract MIPR-FY7616-84-00424)
(AD-A165878; NPS-61-86-009) Avail: NTIS HC A03/MF A01 CSCL 04/1

A simplified method is presented for making atmospheric diffusion estimates. The method is applied to the Space Shuttle HC1 exhaust hazard at Vandenberg Air Force Base. A set of standard parameters and results are developed and applications to specific areas are included. GRA

N86-28991# Stuttgart Univ. (West Germany).
PLASMA THRUSTER DEVELOPMENT: MAGNETOPLASMADYNAMIC PROPULSION, STATUS AND BASIC PROBLEMS Interim Report, Oct. 1984 - Sep. 1985
Rolf D. Buehler Feb. 1986 108 p Prepared in cooperation with AF Rocket Propulsion Lab., Edwards AFB, Calif.
(Grant AF-AFOSR-0394-84)
(AD-A165945; IRA-85-P6; AFRPL-TR-86-013) Avail: NTIS HC A06/MF A01 CSCL 21/3

This report provides an overview of the present state and the problem areas of magnetoplasmadynamic (MPD) space propulsion devices and systems potentially suitable for orbit raising and maneuvering of large space structures, i.e., thrust and power levels of presently most promising steady (or quasisteady pulsed) thruster types, self field, axial applied field arcjets and Hall ion thrusters are reviewed in terms of performance trends, present understanding, uncertainties and ground testing problems, with the conclusion that there is as yet no reliable basis for choosing one type for final development. Typical efficiency vs. specific impulse curves for all MPD thrusters show the dominant role of the

propellant on the thrust to input power ratio (as for ion engines), and the necessity of achieving relatively high specific impulse values for each propellant for acceptable efficiencies. The specific impulse (or onset) limit of self-field thrusters using a variety of propellants is discussed, together with predicted trends from several theoretical models. Considering system complexity and development cost as well as performance, the advantages and disadvantages if pulsed (quasisteady) vs. continuous thruster operation and the propellant selection criteria are reviewed. Electrode erosion, especially on cathodes, losses and limits imposed by radiation cooling are emphasized as critical problem areas for larger MPD thrusters. GRA

23 CHEMISTRY AND MATERIALS (GENERAL)

Includes biochemistry and organic chemistry.

N86-28992*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ALGORITHMS VERSUS ARCHITECTURES FOR COMPUTATIONAL CHEMISTRY
Harry Partridge and Charles W. Bauschlicher, Jr. Jan. 1986 24 p
(NASA-TM-89395; RIACS-TR-86.3; NAS 1.15:89395) Avail: NTIS HC A02/MF A01 CSCL 07A

The algorithms employed are computationally intensive and, as a result, increased performance (both algorithmic and architectural) is required to improve accuracy and to treat larger molecular systems. Several benchmark quantum chemistry codes are examined on a variety of architectures. While these codes are only a small portion of a typical quantum chemistry library, they illustrate many of the computationally intensive kernels and data manipulation requirements of some applications. Furthermore, understanding the performance of the existing algorithm on present and proposed supercomputers serves as a guide for future programs and algorithm development. The algorithms investigated are: (1) a sparse symmetric matrix vector product; (2) a four index integral transformation; and (3) the calculation of diatomic two electron Slater integrals. The vectorization strategies are examined for these algorithms for both the Cyber 205 and Cray XMP. In addition, multiprocessor implementations of the algorithms are looked at on the Cray XMP and on the MIT static data flow machine proposed by DENNIS. Author

N86-28993# Lawrence Livermore National Lab., Calif.
CHEMISTRY RESEARCH RESOURCE Progress Report, Dec. 1985
Jan. 1986 83 p
(Contract W-7405-eng-48)
(DE86-008163; UCID-20622-85-12) Avail: NTIS HC A05/MF A01

Research is reported into the following fields: synthesis of new materials, analytical techniques, chemical kinetics and transport processes, artificial intelligence, materials characterization techniques, materials modeling analysis, mechanical properties of polymers, physical metallurgy (mechanical properties, phase transformations), surface modification and surface studies, and new materials development and properties. DOE

24 COMPOSITE MATERIALS

Includes laminates.

N86-28994*# Santa Clara Univ., Calif.
AN INVESTIGATION OF THE ADSORPTION CHARACTERISTICS OF 5'ATP AND 5'AMP ONTO THE SURFACE OF CaSO4 X 2H2O Final Technical Report
John Calderon and M. A. Sweeney 1984 13 p
(Contract NCC2-170)
(NASA-CR-177005; NAS 1.26:177005) Avail: NTIS HC A02/MF A01 CSCL 07D

A model has been proposed in which solid surfaces can act as a site for cataletic activity of condensation reactions for certain biomolecules. From this model, the adsorption characteristics of 5'ATP and 5'AMP onto the surface of CaSO4.2H2O was chosen for study. It has been proven that 5'ATP and 5'AMP do adsorb onto the surface of CaSO4. Studies were then made to determine the dependence of absorption versus time, concentration, ionic strength and pH. It was found that the adsorption of the nucleotides is highly pH dependent, primarily determined by the phosphate acid groups of the nucleic acid molecule. From this investigation, the data obtained is discussed in relation to the model for the prebiotic earth. Author

N86-28995*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
ANALYSIS OF DELAMINATION GROWTH FROM MATRIX CRACKS IN LAMINATES SUBJECTED TO BENDING LOADS
Gretchen Bostaph Murri and E. Gail Guynn Jul. 1986 39 p
Prepared in cooperation with Army Aviation Systems Command, St. Louis, Mo.
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-87754; NAS 1.15:87754; USAAVSCOM-TM-86-B-2) Avail: NTIS HC A03/MF A01 CSCL 11D

A major source of delamination damage in laminated composite materials is from low-velocity impact. In thin composite laminates under point loads, matrix cracks develop first in the plies, and delaminations then grow from these cracks at the ply interfaces. The purpose of this study was to quantify the combined effects of bending and transverse shear loads on delamination initiation from matrix cracks. Graphite-epoxy laminates with 90 deg. plies on the outside were used to provide a two-dimensional simulation of the damage due to low-velocity impact. Three plate bending problems were considered: a 4-point bending, 3-point bending, and an end-clamped center-loaded plate. Under bending, a matrix crack will form on the tension side of the laminate, through the outer 90 deg. plies and parallel to the fibers. Delaminations will then grow in the interface between the cracked 90 deg. ply and the next adjacent ply. Laminate plate theory was used to derive simple equations relating the total strain energy release rate, G, associated with the delamination growth from a 90 deg. ply crack to the applied bending load and laminate stiffness properties. Three different lay-ups were tested and results compared. Test results verified that the delamination always formed at the interface between the cracked 90 deg. ply and the next adjacent ply. Calculated values for total G sub c from the analysis showed good agreement for all configurations. The analysis was able to predict the delamination onset load for the cases considered. The result indicated that the opening mode component (Mode I) for delamination growth from a matrix crack may be much larger than the component due to interlaminar shear (Mode II). Author

N86-28996*# National Aeronautics and Space Administration, Washington, D.C.
DAMPING CHARACTERISTICS OF DAMAGED FIBER COMPOSITE COMPONENTS
K. Eberle Jul. 1986 18 p Transl. into ENGLISH of conference paper "Daempfungsverhalten Geschaedigter Faserverbundbauteile" presented at the DGLR Symposium ueber Entwicklung und Anwendung von CFk-Strukturen, 1984 p 1-12 Symposium held in Berlin, West Germany, 8-9 Nov. 1984 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88449; NAS 1.15:88449; DGLR-84-159) Avail: NTIS HC A02/MF A01 CSCL 11D

Defects in fiber composite components produce changes with respect to the vibrational characteristics of the material. These changes can be recognized in the form of a frequency shift or an alteration of the damping process. The present investigation is concerned with questions regarding the possibility of a utilization of the changes in suitable defect-detecting inspection procedures. A description is given of a method for measuring the damping

characteristics of a specimen. This method provides a spectrum of the damping coefficients of the sample as a basis for a comprehensive evaluation of the damping behavior. The correlation between defects and change in the damping characteristics is demonstrated with the aid of results obtained in measurements involving specimens of carbon-fiber composites and a component consisting of glass-fiber-reinforced plastics. Author

N86-28997*# National Aeronautics and Space Administration, Washington, D.C.
SINTERING AND PROPERTIES OF Si3N4 WITH AND WITHOUT ADDITIVES BY HIP TREATMENT
S. Kuratani, M. Shimada, and M. Koizumi Mar. 1986 19 p Transl. into ENGLISH from Japan Society of Materials Science Journal (Japan), v. 33, no. 374, NOv. 1984 p 1372-1377 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88386; NAS 1.26:88386; ISSN-0514-5163) Avail: NTIS HC A02/MF A01 CSCL 11D

Hot Isostatic Pressing (HIP) of Si3N4 powders with and without additives was performed using a glass container, and various kinds of pressureless-sintered Si3N4 were HIP'ed without a container. The effects of HIP treatment on density, microstructure, flexural strength, microhardness, and fracture toughness on Si3N4 ceramics were studied. Using a glass container it was difficult to reach theoretical density. The microhardness of HIP'ed Si3N4 without additives was low, and the fracture toughness of HIP'ed Si3N4 with and without additives was 22 to 25 W/m-K, and it decreased with increasing the amount of additives. The density and flexural strength, and hardness of pressureless-sintered Si3N4 which contained Al2O and Y2O3 as oxide additives were remarkably improved by HIP treatment using nitrogen as a pressure transmitting gas. It is very important to select the sintering conditions for fabricating the presintered body of Si3N4 in order to improve the mechanical properties of Si3N4 by HIP treatment. Author

N86-28998*# National Aeronautics and Space Administration, Washington, D.C.
LEAF SPRING MADE OF FIBER-REINFORCED RESIN
Junichi Hori Apr. 1986 9 p Transl. into ENGLISH of Japanese Patent no. 58-77941 (Appl. no. 56-17499, 31 Oct. 1981) p 217-219 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88415; NAS 1.15:88415) Avail: NTIS HC A02/MF A01 CSCL 11D

A leaf spring made of a matrix reinforced by at least two types of reinforcing fibers with different Young's modulus is described in this Japanese patent. At least two layers of reinforcing fibers are formed by partially arranging the reinforcing fibers toward the direction of the thickness of the leaf spring. A mixture of different types of reinforced fibers is used at the area of boundary between the two layers of reinforced fibers. The ratio of blending of each type of reinforced fiber is frequently changed to eliminate the parts where discontinuous stress may be applied to the leaf spring. The objective of this invention is to prevent the rapid change in Young's modulus at the boundary area between each layer of reinforced fibers in the leaf spring. Author

N86-28999*# National Aeronautics and Space Administration, Washington, D.C.
THERMODYNAMIC METHOD OF CALCULATING THE EFFECT OF ALLOYING ADDITIVES ON INTERPHASE INTERACTION IN COMPOSITE MATERIALS
L. I. Tuchinsky Mar. 1986 14 p Transl. into ENGLISH from Fiz. Khim. Obrab. Mater. (USSR), no. 1, 1979 p 121-126 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88391; NAS 1.15:88391) Avail: NTIS HC A02/MF A01 CSCL 11D

The effect of alloying additives to the matrix of a composite on the high temperature solubility rate of a single component fiber was analyzed thermodynamically. With an example of binary Ni alloys, with Group IV-VI transition metals reinforced with W fibers, agreement between the calculated and experimental data was demonstrated. Author

N86-29000# Argonne National Lab., Ill.
COMPOSITE MATERIALS FOR HIGH HEAT AND PARTICLE FLUX COMPONENTS IN FUSION DEVICES
A. R. Krauss, D. M. Gruen, J. N. Brooks, and A. B. DeWald 1985 19 p Presented at the 32nd National Vacuum Symposium and Topical Conference, Houston, Tex., 19 Nov. 1985 Prepared in cooperation with Georgia Inst. of Tech., Atlanta
(Contract W-31-109-eng-38)
(DE86-004072; CONF-851174-21) Avail: NTIS HC A02/MF A01

We discuss the use of composite materials based on the use of self-sustaining coatings to reduce sputtering-induced erosion in magnetic confinement fusion devices while providing enhanced high-heat flux properties. One material, a copper-lithium alloy has been described previously. A second group of materials consists of porous tungsten, tungsten carbide, or tantalum, impregnated with an alkali metal alumino-silicate. These materials form an alkali metal overlayer similar to that found on the Cu-Li alloy. A third group of materials is obtained by infiltrating the porous high-Z refractory metal with an alkali metal-bearing alloy such as Cu-Li or Al-Li. These materials combine the high thermal conductivity of the infiltrate material with the high-temperature strength and melt layer stability of tungsten or tantalum. Calculations of the sputtering properties indicate that it may be possible to use a tungsten composite limiter at plasma edge temperatures up to approx. 300 eV. DOE

N86-29001# Idaho Univ., Moscow. Dept. of Mechanical Engineering.
DAMPING CAPACITY MEASUREMENTS FOR CHARACTERIZATION OF DEGRADATION IN ADVANCED MATERIALS
R. Mantena, R. F. Gibson, and T. A. Place 1986 16 p Presented at the 31st National Symposium and Exhibition of the Society for the Advancement of Material and Process Engineering, Las Vegas, Nev., 8 Apr. 1986
(Contract DE-AC07-76ID-01570)
(DE86-007656; EGG-M-30485; CONF-860438-2) Avail: NTIS HC A02/MF A01

This paper describes the application of damping capacity measurements for characterization of degradation in advanced materials. A recently developed impulse-frequency response technique was used to obtain damping capacity measurements on crossplied E-glass/epoxy laminates which had been subjected to four-point bending and cantilever bending to produce matrix cracking in the transverse plies. The size and location of the damage zone were correlated with changes in damping. With the expected introduction of Rapidly Solidified Alloys (RSA) as effective alternatives to conventional materials, the applicability of damping capacity measurements as a nondestructive means of evaluating degradation in these materials was also studied. A conventional A710 structural steel having three different microstructures was used for developing the methodology to be used later on RSA specimens. It is shown that damping is more sensitive to matrix cracking than stiffness is in E-glass/epoxy composite specimens. In the case of A710 steel, the damping changes at low strain, though significant, do not correlate with the mechanical property data. Damping data at high strains does correlate with the mechanical property data, however. DOE

N86-29002# Oak Ridge National Lab., Tenn.
ALUMINA-SIC WHISKER COMPOSITES
T. N. Tiegs and P. F. Becher 1985 6 p Presented at the Automotive Technology Development Contractors' Coordination Meeting, Dearborn, Mich., 20 Oct. 1985
(Contract DE-AC05-84OR-21400)
(DE86-004791; CONF-8510103-5) Avail: NTIS HC A02/MF A01

Previous results have shown that alumina reinforced with SiC whiskers is an attractive material for application in advanced heat engines. This composite exhibits excellent strength and toughness up to temperatures of approx. 1000 C and is very resistant to slow crack growth. Reinforcement of a mullite matrix by the SiC

whiskers has also been demonstrated. Recent experiments have investigated other aspects of applying the SiC whisker-reinforced alumina to heat engines. The results have shown the whisker reinforced alumina to have excellent thermal shock resistance, and a good Weibull modulus (indicating good reliability). Fabrication of high toughness composites by pressureless sintering was found to be a viable process for alumina with whisker contents < 20 vol%. In addition, whisker reinforcement may be combined with transformation toughening in the alumina and mullite matrix system for improved mechanical properties. Isothermal heating tests indicated that oxidation of the SiC whiskers in an alumina matrix caused degradation of mechanical properties in currently developed materials. DOE

N86-29003# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France). New Materials and Processes Lab.
ACOUSTIC EMISSION APPLIED TO OBSERVE DAMAGE IN COMPOSITE MATERIAL HIGH-PRESSURE FLUID STORAGE TANKS
Christian LeFloch 1986 17 p Sponsored by French Ministry of Research and Technology
(SNIAS-861-430-111; ESA-86-97173) Avail: NTIS HC A02/MF A01

Acoustic emission analysis was used on composite material high-pressure fluid storage tanks made by winding resin-impregnated glass fiber around a light alloy liner. The method's advantages and limitations concerning nondestructive testing are shown. Studying acoustic activity in stages of force associated with a damaged model makes it possible to differentiate between several kinds of damage and their levels of importance. Acoustic activity rate data makes it possible to examine the metallic liner's plastic deformation. ESA

N86-29004# Centre d'Essais Aeronautique Toulouse (France). Lab. d'Etudes Materiaux non Metalliques.
ELEMENTARY CHARACTERIZATION OF THE BORON 696 EPOXY UNIDIRECTIONAL PREIMPREGNATED FIBERS [CARACTERISATION ELEMENTAIRE DU PREIMPREGNE TISSUE UNIDIRECTIONNEL BORE 696/ARG 12 (FIBRE SNPE)]
M. Laparliere 1984 72 p In FRENCH
(PV-M3-427200; ESA-86-97194) Avail: NTIS HC A04/MF A01

The performance of boron fibers produced by a pilot plant was tested, establishing the physical chemical characteristics of the preimpregnated product as well as the mechanical properties of the finished composite. The preimpregnation was done using CIBA Arg 12 epoxy. The mechanical properties are slightly inferior to a reference commercial product. The analysis of the Arg 12 resin shows the same basic constituents as the BSL 914 resin, but in different proportions. ESA

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*

N86-29005*# Santa Clara Univ., Calif. Sponsored Projects Office.
AN INVESTIGATION OF THE ADSORPTION CHARACTERISTICS OF 5 PRIME ATP AND 5 PRIME AMP ONTO THE SURFACE OF CaSO SUB 4 X 2H SUB 2 O Final Technical Report
John Calderon and M. A. Sweeney 1986 13 p
(Contract NCC2-170)
(NASA-CR-177101; NAS 1.26:177101) Avail: NTIS HC A02/MF A01 CSCL 07D

A model has been proposed (Lahev and Chans, 1982) in which solid surfaces can act as a site for catalytic activity of condensation reactions for certain biomolecules. From this model, the adsorption characteristics of 5'ATP and 5'AMP onto the surface of CaSO4 2H2O was chosen for study. It has been proven that 5'ATP and 5'AMP do adsorb onto the surface of CaSO4. Studies were then made to determine the dependence of adsorption versus time, concentration, ionic strength and pH. It was found that the adsorption of the nucleotides is highly pH dependent, primarily determined by the phosphate acid groups of the nucleic acid molecule. From this investigation, the data obtained are discussed in relation to the model for the prebiotic earth. Author

N86-29006*# Eloret Corp., Sunnyvale, Calif.
STRUCTURAL CHARACTERIZATION AND GAS REACTIONS OF SMALL METAL PARTICLES BY HIGH RESOLUTION IN-SITU TEM AND TED Semiannual Technical Report, 1 Jul. - 30 Sep. 1985
Klaus Heinemann 30 Sep. 1985 35 p
(Contract NCC2-283)
(NASA-CR-177031; NAS 1.26:177031) Avail: NTIS HC A03/MF A01 CSCL 07D

A commercial electron microscope with flat-plate upper pole piece configuration of the objective lens and top entry specimen introduction was modified to obtain 5 x 10 to the minus 10th power mbar pressure at the site of the specimen while maintaining the convenience of a specimen airlock system that allows operation in the 10 to the 10th power mbar range within 15 minutes after specimen change. The specimen chamber contains three wire evaporation sources, a specimen heater, and facilities for oxygen or hydrogen plasma treatment to clean as-introduced specimens. Evacuation is achieved by dural differential pumping, with fine entrance and exit apertures for the electron beam. With the microscope operating at .000001 mbar, the first differential pumping stage features a high-speed cryopump operating in a stainless steel chamber that can be mildly baked and reaches 1 x 10 to the minus 8th power mbar. The second stage, containing the evaporation sources and a custom ionization gauge within 10 cm from the specimen, is a rigorously uncompromised all-metal uhv-system that is bakable to above 200 C throughout and is pumped with an 80-liter ion pump. Design operating pressures and image quality (resolution of metal particles smaller than 1 nm in size) was achieved. Author

N86-29007*# National Aeronautics and Space Administration, Washington, D.C.
DEVELOPMENT OF A POTENTIOMETRIC EDTA METHOD FOR DETERMINATION OF MOLYBDENUM. USE OF THE ANALYSIS FOR MOLYBDENITE CONCENTRATES
R. Khristova and Mac VanMen Jun. 1986 13 p Transl. into ENGLISH from Khim. Fak. (Sofia, Bulgaria), 1976 p 243-251 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88460; NAS 1.15:88460) Avail: NTIS HC A02/MF A01 CSCL 07D

Based on considerations of principles and experimental data, the interference of sulfate ions in poteniometric titration of EDTA with FeCl3 was confirmed. The method of back complexometric titration of molybdenum of Nonova and Gasheva was improved by replacing hydrazine sulfate with hydrazine hydrochloride for reduction of Mo(VI) to Mo(V). The method can be used for one to tenths of mg of molybdenum with 0.04 mg standard deviation. The specific method of determination of molybdenum in molybdenite concentrates is presented. Author

N86-29008*# National Aeronautics and Space Administration, Washington, D.C.
ELECTROLYSIS CELL FOR THE MANUFACTURE OF PERSULFATES
J. M. Cueto Jul. 1986 10 p Transl. into ENGLISH of German Patent no. 19-08-872 (18 Jun. 1970) p 1-7 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4004)
(NASA-TM-88466; NAS 1.15:88466) Avail: NTIS HC A02/MF A01 CSCL 07D

A cell for the electrolytic generation of persulfates, characterized by the fact that a housing acts as cathode, is made of

metal, and consists of a lower electrolytically active section and an upper electrolytically inactive section. It is designed so that there is produced the greatest possible current density suited to produce the desired electrolysis effect. This invention, compared to the devices used until now, exhibits considerable advantages whereby it is particularly suited for the production of potassium persulfate. Author

N86-29009*# National Aeronautics and Space Administration, Washington, D.C.
OPTIMIZATION OF THE GEOMETRIC DIMENSIONS OF VERTICAL ELECTROLYZERS WITH GAS-GENERATING ELECTRODES
Wolfgang Thiele and Martin Schleiff Jul. 1986 8 p Transl. into ENGLISH from Chemische Technik (Leipzig, East Germany), v. 31, no. 12, Dec. 1979 p 623-624 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4004)
(NASA-TM-88468; NAS 1.15:88468) Avail: NTIS HC A02/MF A01 CSCL 07D

A study is made to determine whether, under the conditions of electrolyte circulation induced by evolved gases, it is possible to increase the vertical scale without a great increase in cell voltage. The mathematical modeling used is discussed, and a comparison is made with experimental results and conclusions. It is found that it is possible to increase the vertical scale without producing a cell voltage increase. Author

N86-29010*# National Aeronautics and Space Administration, Washington, D.C.
CONCERNING THE ELECTROSYNTHESIS OF HYDROGEN PEROXIDE AND PEROXODISULFATES. SECTION 2: OPTIMIZATION OF ELECTROLYSIS CELLS USING AN ELECTROLYZER FOR PEROXODISULFURIC ACID AS AN EXAMPLE
Martin Schleiff, Wolfgang Thiele, and Hermann Matschiner Jul. 1986 17 p Transl. into ENGLISH from Chemische Technik (Leipzig, East Germany), v. 29, no. 12, Dec. 1977 p 679-683 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4004)
(NASA-TM-88467; NAS 1.15:88467) Avail: NTIS HC A02/MF A01 CSCL 07D

The model is presented of an electrolyzer for peroxodisulfuric acid, and it is analyzed mathematically. Its application for engineering and economic optimization is investigated in detail. The mathematical analysis leads to conclusions concerning the change in position of the optimum with respect to the various target functions due to changes of the individual design-caused and economic parameters. Author

N86-29011*# National Aeronautics and Space Administration, Washington, D.C.
COMBUSTION THEORY FOR LIQUIDS WITH A FREE SURFACE. 3: SPECIAL PROBLEMS
S. N. Milkov, G. S. Sukhov, and L. P. Yarin Jun. 1986 15 p Transl. into ENGLISH from Fizika Goreniya i Vzryva (USSR), no. 3, 1985 p 3-8 Transl. by The Corporate Word, Inc., Pittsburgh, Pa.
(Contract NASw-4006)
(NASA-TM-88459; NAS 1.15:88459) Avail: NTIS HC A02/MF A01 CSCL 21B

Two special problems concerning the combustion of liquids with a free surface, i.e., flame quenching during the mixing of a burning liquid inside a container and liquid burnout from a porous layer, are analyzed using a quasi-one-dimensional model. The critical parameters corresponding to the quenching of a burning fluid with a free surface are determined. Determinations are also made of the limiting pressure gradients corresponding to the transition from the combustion mode where the liquid evaporates from the surface of a porous layer to the mode where the phase transition surface lies inside the porous layer. Author

N86-29012# Catholic Univ. of America, Washington, D.C. Dept. of Chemistry.
REACTION INTERMEDIATES IN AROMATIC FUEL COMBUSTION Final Report, 18 Jul. 1984 - 17 Jul. 1985
William A. Sanders 17 Jul. 1985 36 p
(Contract N00014-84-C-2295)
(AD-A165998) Avail: NTIS HC A03/MF A01 CSCL 07/3

There is increasing tendency in future fuels to have higher aromatic contents because partly of the change in fuel sources (such as coals and shale oils) and partly of the greater use of aromatic compounds as additives due to their high octane values. The chemistry of the oxidation of aromatic compound at combustion temperatures (T > 1500 K) is very complex and poorly understood. This study is part of a series of experiments being carried out to elucidate the oxidation mechanism of C6H6, the most important benchmark system for the aromatic compounds. The unimolecular decomposition of methylphenyl ether (anisole) was studied in incident shock waves covering the temperature range from 1000 to 1580 K and the pressure range from 0.4 to 0.9 atm. The carbon monoxide formed in the reaction, monitored by resonance absorption using a stabilized cw CO laser, could be satisfactorily accounted for by a four-reaction mechanism: C6H5OCH3 yields C6H5O + CH3; C6H5O yields CO + C5H5; CH3 + C6H5O yields o- and p-CH3C6H4OH; and CH3 + CH3 yields C2H6. GRA

N86-29013# Sverdrup Technology, Inc., Arnold Air Force Station, Tenn.
HIGH-RESOLUTION TUNABLE DIODE LASER SPECTROSCOPY OF METHANE Final Report, 1 Oct. 1981 - 30 Sep. 1983
H. C. Walker, Jr. and W. J. Phillips AEDC Mar. 1986 45 p Prepared in cooperation with AEDC, Arnold AFS, Tenn.
(AD-A166000; AEDC-TR-85-37) Avail: NTIS HC A03/MF A01 CSCL 07/4

The feasibility of using tunable diode laser spectroscopy for measurement of methane concentration in turbine engine exhausts was investigated. An experimental program was accomplished in which the foreign gas broadening parameters of the methane R(O)A line of the v3 fundamental band were measured for nitrogen and carbon dioxide broadening. The temperature range was extended from the room temperature data available in the literature to 1000K, typical of turbine engine exhausts. The range of concentrations and path lengths over which the technique is feasible was established. A literature survey on typical turbine engine emissions was conducted from which it was determined that the technique may be applicable at augmented power settings, but methane concentrations are too small for idle and intermediate power settings. GRA

N86-29014# Sandia National Labs., Albuquerque, N. Mex.
OXIDATION OF SOCl ELECTROLYTE ON Mo, Ta, W AND Pt ELECTRODES
F. M. Delnick and W. R. Cieslak Nov. 1985 15 p
(Contract DE-AC04-76DP-00789)
(DE86-003987; SAND-85-0015) Avail: NTIS HC A02/MF A01

The oxidation of 1.5 M LiAlCl4/SOCl2 electrolyte on Mo, Ta, W, and Pt electrodes is evaluated using complex impedance and steady-state polarizations. All four metals behave as inert, film-free electrodes in the SOCl2 electrolyte with the same differential double-layer capacitance of 11 to 12 microF/sq cm at E greater than or equal to 4.7 V vs. Li/LiCl. DOE

N86-29015# Pacific Northwest Lab., Richland, Wash.
TECHNIQUE FOR COMPARING AES SIGNALS FROM DIFFERENT SPECTROMETERS USING COMMON MATERIALS
D. R. Baer and M. T. Thomas Oct. 1985 17 p Presented at the 32nd National Vacuum Symposium and Topical Conference, Houston, Tex., 19 Nov. 1985
(Contract DE-AC06-76RL-01830)
(DE86-004857; PNL-SA-13275; CONF-851174-26) Avail: NTIS HC A02/MF A01

A simple procedure is outlined to obtain relative sensitivity curves that allow data collected on one Auger electron spectrometer to be related to data collected on a different spectrometer or to a standard data set. Data collected on three single pass cylindrical mirror analyzer (CMA) systems demonstrate that dN/dE

peak to peak amplitude ratios for pure elements can vary considerably but in a systematic manner for different systems. Such differences can be produced by variations in system design, by specimen or electron gun alignment, spectrometer contamination or other problems. However, if the differences in relative sensitivity are considered in the data analysis, data sets from different systems can be interrelated with reasonable accuracy. DOE

N86-29016# Yale Univ., New Haven, Conn.
SIMULTANEOUS MULTIPOINT MEASUREMENTS OF DENSITY GRADIENTS AND TEMPERATURE IN A FLAME Final Report, 1 Jul. 1981 - 31 Jul. 1985
R. K. Chang, B. T. Chu, and M. B. Long Nov. 1985 19 p
(Contract DE-AC02-81ER-10969)
(DE86-005124; DOE/ER-10969/T1) Avail: NTIS HC A02/MF A01

A summary is given of research directed toward the study of turbulent reacting and nonreacting flows by nonintrusive in situ optical techniques. New diagnostic techniques were developed for the instantaneous mapping of species concentration and temperature in turbulent flames in one or two dimensions. A number of different light scattering mechanisms were utilized including Rayleigh scattering, spontaneous Raman scattering, and coherent anti-Stokes Raman scattering (CARS). Progress was also made on the use of newly-available, high-speed imaging devices which allow the two-dimensional mapping of the flows at rates high enough to follow their temporal evolution. DOE

N86-29017# Department of Energy, Washington, D. C.
FOURTH SYMPOSIUM ON SEPARATION SCIENCE AND TECHNOLOGY FOR ENERGY APPLICATIONS: ABSTRACTS
1985 74 p Presented at the 4th Symposium on Separation Science and Technology for Energy Applications, Knoxville, Tenn., 20 Oct. 1985 Prepared in cooperation with Oak Ridge National Lab., Tenn.; American Chemical Society, Washington, D.C.; National Research Council, Washington, D.C.
(Contract DE-AC05-84OR-21400)
(DE86-005173; CONF-851011-Absts) Avail: NTIS HC A04/MF A01

This report contains a collection of abstracts from the conference. There were 7 sessions covering: solvent extraction, sorption processes, posters, supercritical and solid-fluid systems, solvent extraction, membrane separations, and separations in dilute solutions. DOE

N86-29018# Catholic Univ. of America, Washington, D.C. Dept. of Chemistry.
KINETICS AND MECHANISMS OF KEY ELEMENTARY PROCESSES OF IMPORTANCE OF HIGH TEMPERATURE COMBUSTION CHEMISTRY Technical Progress Report, May 1 - 12 Dec. 1985
M. C. Lin 1985 8 p
(Contract DE-FG05-85ER-13373)
(DE86-005419; DOE/ER-13373/1) Avail: NTIS HC A02/MF A01

Activities summarized in this report include: improvements to the shock tube data system; kinetics and mechanism of the reaction system CH + C H O; high temperature rate constants for CH + N HCN + NH; kinetics of the methylidyne radical; modelling of the system OH + C H; and high temperature kinetics of the system C H + NO. DOE

N86-29019# Sandia National Labs., Albuquerque, N. Mex.
THE EFFECT OF SHOCK PRESSURE AND TEMPERATURE ON THE DEFORMATION MICROSTRUCTURE OF RUTILE
Martin J. Carr and Robert A. Graham 1985 21 p
(Contract DE-AC04-76DP-00789)
(DE85-016577; SAND-85-1661C) Avail: NTIS HC A02/MF A01

Annealed high purity rutile powders were shock loaded to peak pressures between 5 and 22 GPa and peak temperatures between 80 and 500 C, and then examined by transition electron microscopy. Unusually large concentrations of dislocations were observed even at the lowest pressure. They increased in density rapidly with peak pressure, exceeding 10 to the 11th power square cm above 8 GPa. Twinning was present at all pressures, but was more difficult to discern amid the dense substructure at higher pressures. Cleavage was common at 5 to 8 GPa, but rare at higher pressures. Recrystallized grains were observed at 16 GPa and 500 C. The occurrence of slip or twinning was affected by crystal orientation. Particle size and grain size were not significantly altered by shock compression. Slip on (100) planes was observed for the first time for this material. Crystallographic shear defects were not observed. DOE

N86-29020# Oak Ridge Gaseous Diffusion Plant, Tenn.
HYDROGEN FLUORIDE: PART 1: SPECIFIC HEAT, STEAM PRESSURE AND DENSITY UP TO 300 DEG C AND 300at
E. U. Franck (Goettingen Univ., West Germany) and W. Spalthoff 1986 21 p Prepared in cooperation with Goettingen Univ. (Germany, F.R.). Inst. fuer Physikalische Chemie.
(Contract DE-AC05-84OT-21400)
(DE86-008133; K-Trans-86/5) Avail: NTIS HC A02/MF A01

Specific heat c sub v , pressure p and density rho of pure hydrogen fluoride were first measured at temperatures of up to 300C and 300 at. pressure. For this purpose, a tight and corrosion proof high pressure calorimeter with a capacity of 0.5 liter and 120 cal/degree of heat capacity was designed. The contents were heated by an integral heating element. Details of the equipment and the measuring process will be described. The densities of the liquid and gaseous HF were between 0.96 and 0.04 g/cm(3). The results for c sub r (T, rho) and p (T, rho) have been tabulated. Noticeable are the high c sub r values up to 2 cal/g degree, or the 40 cal mol degree for subcritical densities. The isotherms of the specific heat between 190 and 259C between 190 and 250C show definite maximum values between rho = 0.04 and rho = 0.2 g/cm(3). The measurements showed also the pressures and the equilibrium densities and steam and liquid. The critical HF data at f sub kr = 3C, P sub kr = 66.2 +- 3.5 kg/cm(2) and rho sub kr = 0.29 +- 0.03 g/cm(3). The vaporization rate increases from 89.5 cal/g at 19.4C to a maximum of 146 cal/g at 130C, shows still 101 cal/g at 170C and then drops rapidly. DOE

N86-29021# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
PRELIMINARY STUDY OF FLAME STRUCTURE IN AN INTERNAL COMBUSTION ENGINE USING 2-D FLOW VISUALIZATION
A. O. zurLoye, F. V. Bracco, and D. A. Santavicca (Pennsylvania State Univ., University Park) 1985 10 p Presented at the International Symposium on Diagnostics and Modeling of Combustion in Reciprocating Engines, Tokyo, Japan, 4 Sep. 1985 Prepared in cooperation with Pennsylvania State Univ., University Park
(Contract DE-AC04-81AL-16338)
(DE86-008172; CONF-850915-2) Avail: NTIS HC A02/MF A01

The structure of the turbulent flame in a premixed charge internal combustion engine was investigated at engine speeds of 300, 600, 1200, and 1800 rpm. A laser sheet, 200 microns thick and 1 cm wide, was passed through the turbulent flame front and the intensity of the light scattered by seeding particles was measured, thus obtaining two-dimensional (2-D) cross-sections of the flame front. At the lower engine speeds the flame fronts were mostly continuous with some apparent pockets of unburned gas. As the engine speed was increased the flame fronts were more strongly distorted and the frequency of what appeared to be multiply connected flame sheets increased. The measured flame thicknesses varied from 300 microns to 1000 microns with the larger values more common at higher speeds. At least some of the variation was due to the flame being tilted with respect to the laser sheet but uncertainties persist as to the accuracy of the measured thicknesses. DOE

N86-29022# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France).
COMPARISON OF CLAY-WATER SYSTEMS AND OF ALUMINUM HYDROXIDE GELS IN ACIDIC MEDIUM
A. C. Pierre and D. R. Uhlmann 1986 16 p
(SNIAS-861-430-109; ESA-86-97171) Avail: NTIS

HC A02/MF A01

The properties of alumina sols and gels made by hydrolysis of aluminum sec-butoxide in an acidic medium, and clay-water systems are compared. A gelation mechanism of boehmite by electrostatic linking between the negatively charged edges and the positively charged faces of platlet particles is proposed. The negative charges on the edges could be due to several possible mechanisms, such as the attraction of the anions such as NO3 by the edge Al cations. The mechanism proposed explains the high gelation volume in highly acidic conditions, and the existence of a minimum in the volume at gel point in the low acidic concentration range. It also explains the aging behavior by a cleavage of the boehmite platlets. ESA

N86-29023# Max-Planck-Inst. fuer Plasmaphysik, Garching (West Germany).

DEPENDENCE OF SURFACE TENSION ON VAPOR PRESSURE AND FLUID DENSITY. NUMERICAL TREATMENT OF MEASURING DATA AND DESCRIPTION OF THE PHASE TRANSITION IN SIMPLE FLUIDS [ABHAENGIGKEIT DER OBERFLAECHENSPANNUNG VON DAMPFDRUCK UND FLUIDDICHTE. NUMERISCHE BEHANDLUNG DER MESSDATEN UND BESCHREIBUNG DES PHASENUEBERGANGS BEI EINFACHEN FLUIDEN]

Albrecht Elsner May 1985 81 p In GERMAN

(IPP-2/261; ESA-86-96928) Avail: NTIS HC A05/MF A01

The relation g between surface tension, vapor pressure, and density of fluid and vapor was investigated for 26 fluids. The function of state g for a two-phase system with free phase surface describes the phase transition following the principle of corresponding state of real gases. The knowledge of g allows the calculation of the surface tension of a fluid from the data of vapor pressure and density only. The scaling of the surface tension in the critical point and the absolute zero point was theoretically determined using a correlation function formulating the phase transition in the domain of critical fluctuations. The critical exponent for the surface tension, and the exponent for fluids are determined. ESA

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N86-29024*# Eloret Corp., Sunnyvale, Calif.

THE CORRELATION OF STRUCTURAL, CHEMICAL, AND ELECTRONIC PROPERTIES OF SMALL METAL PARTICLES AND THEIR ALLOYS Final Technical Report, 20 May 1982 - 31 Jul. 1983

31 Jul. 1983 25 p

(Contract NCC2-193)

(NASA-CR-177116; NAS 1.26:177116; EI-84-0408) Avail: NTIS HC A02/MF A01 CSCL 11F

The low pressure interaction of CO with small Ru particles supported on ultrahigh vacuum (UHV) cleaved mica was studied using flash thermal desorption, Auger electron microscopy, transmission electron microscopy, and transmission electron diffraction. Average particle sizes for these experiments varied between 1.2 and 16 nm. A careful search for CO decomposition on the Ru particles revealed no evidence of dissociation over a temperature range and pressure range of 300 to 550 C and 10 to the minus 11th power to 10 to the minus 6th millibar, respectively. Gas and heat treatments caused significant morphological changes and dispersion in the Ru particles, which affected CO desorption. These effects were dependent on the particle size. Author

N86-29025*# Eloret Corp., Sunnyvale, Calif.

HIGH-RESOLUTION SURFACE ANALYSIS BY MICROAREA AUGER SPECTROSCOPY: COMPUTERIZATION AND CHARACTERIZATION Final Technical Report, 15 Aug. 1982 - 15 Feb. 1985

Raymond Browning Apr. 1986 20 p

(Contract NCC2-203)

(NASA-CR-177033; NAS 1.26:177033) Avail: NTIS HC A02/MF A01 CSCL 11F

A custom scanning Auger electron microscope (SAM) capable of introducing a 3-5 keV electron beam of several nA into a 30 nm diameter sample area was fitted with a sample introduction system and was fully computerized to be used for materials science research. The method of multispectral Auger imaging was devised and implemented. The instrument was applied to various problems in materials science, including the study of the fiber/matrix interface in a SiC reinforced titanium alloy, the study of SiC whiskers in Al alloy 2124 (in cooperation with NASA-Langley), the study of NiCrAl superalloys (in collaboration with NASA-Lewis), the study of zircalloy specimens (in collaboration with Stanford University), and the microstructure of sintered SiC specimens (in collaboration with NASA-Lewis). The report contains a number of manuscripts submitted for publication on these subjects. Author

N86-29026*# National Aeronautics and Space Administration, Washington, D.C.

BORON DETERMINATION IN STEELS BY INDUCTIVELY-COUPLED PLASMA SPECTOMETRY (ICP)

A. Gomez Coedo and M. T. Dorado Lopez Jun. 1986 14 p Transl. into ENGLISH from Rev. Metal. (Madrid, Spain), v. 21, no. 2, Mar. - Apr. 1985 p 87-90 Transl. by Scientific Translation Service, Santa Barbara, Calif.

(Contract NASw-4004)

(NASA-TM-88434; NAS 1.15:88434) Avail: NTIS HC A02/MF A01 CSCL 11F

The sample is treated with 5N H2SO4 followed by concentrated HNO3 and the diluted mixture is filtered. Soluble B is determined in the filtrate by Inductively-Coupled Plasma (ICP) spectrometry after addition HCl and extraction of Fe with ethyl-ether. The residue is fused with Na2CO3 and, after treatment with HCl, the insoluble B is determined by ICP spectrometry as before. The method permits determination of ppm amounts of B in steel. Author

N86-29027# Army Armament Research and Development Command, Watervliet, N. Y. Close Combat Armaments Center.

YOUNG'S MODULUS AND POISSON'S RATIO OF STEEL AS STRESS DEPENDENT QUANTITIES Final Technical Report

W. Scholz and J. Frankel Jan. 1986 14 p

(AD-A166415; AD-E440319; ARCCB-TR-86004) Avail: NTIS HC A02/MF A01 CSCL 11/6

Second and third-order elastic constants of 4340 steel obtained from ultrasonic measurements of specimens under zero and moderate uniaxial stresses are used under a continuum mechanics analysis of finite deformation to predict Young's modulus and Poisson's ratio, not only in the stress range of the measurement, but at stresses near the yield point (150,000 psi), where Young's modulus changes by about 2.5 percent, Poisson's ratio by 5 percent (both decrease in tension and increase in comparison). GRA

N86-29028# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Mechanical Behavior of Materials Lab.

CRACK GROWTH IN TITANIUM ALLOYS UNDER THE CONJOINT ACTION OF HIGH AND LOW CYCLE FATIGUE Final Report, 15 Jun. 1983 - 14 Jun. 1985

B. E. Powell and I. Henderson Feb. 1986 77 p

(Contract F49620-83-C-0116)

(AD-A166429; AFWAL-TR-85-4093) Avail: NTIS HC A05/MF A01 CSCL 11/6

Fatigue crack propagation rates have been measured for two titanium-based aeroengine disc alloys using compact tension test pieces. The loading block employed simulates two features of the engine flight pattern. A major stress cycle represents the start-stop operation which leads to low cycle fatigue. In-flight vibrations, which may give rise to high cycle fatigue, are represented by superimposed minor cycles of high frequency. With a lifting policy of retirement for cause the useful lives of blades and discs are limited by the onset of minor cycle crack growth. The threshold values

associated with the minor cycles have been used to predict this event. Similarly the method of linear summation has been used to predict the subsequent fatigue crack growth rates. These predictions are successful for Ti-6Al-4V, whilst for Ti-5331S they are found to be either accurate or safe. Although Ti-5331S displays a marginally greater resistance to the onset of minor cycle crack growth, of greater significance is its reduced crack growth rates prior to this event. As a consequence components fabricated from Ti-5331S will exhibit longer fatigue crack propagation lives when subjected to the conjoint action of high and low cycle fatigue. GRA

N86-29029# Oak Ridge National Lab., Tenn.
EFFECTS OF HELIUM CONTENT OF MICROSTRUCTURAL DEVELOPMENT IN TYPE 316 STAINLESS STEEL UNDER NEUTRON IRRADIATION
P. J. Maziasz Nov. 1985 229 p
(Contract DE-AC05-84OR-21400)
(DE86-005342; ORNL-6121) Avail: NTIS HC A11/MF A01

This work investigated the sensitivity of microstructural evolution, particularly precipitate development, to increased helium content during thermal aging and during neutron irradiation. Helium (110 at. ppM) was cold preinjected into solution annealed (SA) DO-heat type 316 stainess steel (316) via cyclotron irradiation. These specimens were then exposed side by side with uninjected samples. Continuous helium generation was increased considerably relative to EBR-2 irradiation by irradiation in high frequency infrared radiation. Data were obtained from quantitative analytical electron microscopy (AEM) in thin foils and on extraction replicas. DOE

N86-29030# Sandia National Labs., Albuquerque, N. Mex.
FORMATION OF ICOSAHEDRAL Al(Mn) BY PULSED SURFACE MELTING
D. M. Follstaedt and J. A. Knapp 1985 5 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985
(Contract DE-AC04-76DP-00789)
(DE86-005442; SAND-85-1277C; CONF-851217-32) Avail: NTIS HC A02/MF A01

Surface melting of alternating Al/Mn layers on Al and Fe substrates by pulsed electron beams and lasers is found by transition electron microscopy (TEM) to produce icosahedral Al(Mn). Interpreting the observed microstructures in terms of the calculated temperature histories places limits on the melting point of the phase (660 C < T sub m < 960 C), the time needed for its nucleation from the melt at 660 C (t sub n < 20 ns), and the rate of quenching from the liquid needed to suppress formation of the competing T phase (-T > approx. 1 x 10 K/s). DOE

N86-29031# Kanner (Leo) Associates, Redwood City, Calif.
CALCULATED AND EXPERIMENTAL OPTIMIZING OF BINARY AND TERNARY SYSTEMS OF Ag, Bi, Pb, AND Tl Ph.D. Thesis
B. Zimmermann (Stuttgart Univ., West Germany) 1986 143 p Transl. into ENGLISH from Rechnerische und Experimentelle Optimierung von Binaren und Ternaren Systemen Aus Ag, Bi, Ph, und Tl (Stuttgart, West Germany) Prepared for Los Alamos National Lab., N. Mex.
(Contract W-7405-eng-36)
(DE86-005962; LA-tr-86-4) Avail: NTIS HC A07/MF A01

A method was developed for the calculation of binary and higher-component diagrams of state and of the thermodynamic functions in these systems. The calculation optimizes the functions of state of the binary systems through simultaneous use of different thermodynamic measured values and of the diagram of state. The calculation of ternary systems takes place through extrapolation of the functions of state of the binary boundary systems. The five binary systems Ag-Bi, Ag-Pb, Ag-Tl, Bi-Pb, and Bi-Tl and the two ternary systems Ag-Bi-Pb and Ag-Bi-Tl are computed. The diagrams of state and the functions of state exhibit good agreement with the measured values. For computed ternary systems, the extrapolation of the functions of state from the boundary systems is only approximate. But with a few measurements, a ternary correction function is obtained which describes the ternary system quite well. Supplemental measurements of liquidus temperatures with DTA was performed in the systems Ag-Tl, Bi-Pb, Ag-Bi-Pb and Ag-Bi-Tl. Mixing enthalpies of the melts, or solution enthalpies in the melts, were measured calorimetrically in the systems Ag-Bi, Ag-Tl, Bi-Tl, Ag-Bi-Pb and Ag-Bi-Tl, and melt enthalpies were measured in the Bi-Tl system. DOE

N86-29032# Allied Bendix Corp., Kansas City, Mo.
QUANTITATIVE METALLOGRAPHIC METHOD FOR DETERMINING DELTA FERRITE CONTENT IN AUSTENITIC STAINLESS STEELS Final Report
G. A. Pressly Jan. 1986 60 p
(Contract DE-AC04-76DP-00613)
(DE86-006311; BDX-613-3350) Avail: NTIS HC A04/MF A01

Delta ferrite is a magnetic form of iron and has a body centered cubic crystal structure. It is often present as a nonequilibrium phase in austenitic stainless steel welds, castings, and wrought materials. The ferrite content of austenitic stainless steel can directly affect its properties, especially weldability and formability. Therefore, it is highly desirable to be able to predict and/or measure the ferrite content accurately. Current magnetic ferrite measuring methods are not applicable when test materials are geometrically small (less than 2.54 mm thick and 6.35 mm wide). Therefore, a standard metallographic test method STM 00107-A was established to determine delta ferrite content in small weldments and base metals of austenitic stainless steel. This standard test method (STM 00107-A) was then performed on several exemplary metallographic specimens to illustrate its capabilities and applications. The results from the exemplary tests were compared and contrasted to metallographic manual point count measurements, Ferritescope measurements, and predicted values calculated from chemical analyses. By utilizing the manual metallographic point count data, an accuracy of + or - 16% and a precision of + or 0.77% were determined for the standard test method. The comparison of Ferritescope data to standard test method revealed that the results obtained by the two methods are close at low (0 to 3%) ferrite contents and Ferritescope results are substantially greater at higher (6 to 10%) ferrite contents. The standard test method data compiled from the exemplary weld specimens was noted to be very similar to the predicted values calculated from chemical analyses. It was also shown that because the standard test method utilizes optics the morphology of the delta ferrite particles can be determined. This type of determination is possible only with metallographic methods. DOE

N86-29033# Lawrence Livermore National Lab., Calif.
EFFECT OF PARTIAL REVERSIBILITY OF DISLOCATION MOTION
A. W. Sleeswyk (Groningen Rijksuniversiteit, Netherlands), M. E. Kassner, and G. J. Kemerink 17 Jan. 1986 18 p Presented at the Symposium on Sur Les Deformations Finies Des Agregats: Bases Physiques Et Modelisations, Paris, France, 30 Oct. 1985 Prepared in cooperation with Rijksuniversiteit Groningen (Netherlands)
(Contract W-7405-eng-48)
(DE86-008015; UCRL-94188; CONF-8510292-1) Avail: NTIS HC A02/MF A01

The partial reversibility of dislocation motion and strain hardening is studied by three different types of experiment. (1) It is shown that the Bauschinger effect in tension/compression tests must be explained by a lost strain and an initial decrease in dislocation density when the mobile dislocations move between barriers after reversal. The model is confirmed by electron microscopy on the change of dislocation density after reversal. (2) Dislocations are made to move back and forth in a thin foil in the HVEM to which mutually perpendicular forces are applied alternatingly (x-y tests). (3) Mechanical analysis predicts that a large fraction of the mobile dislocations does not move when the tensile direction is changed over 90(0). Macroscopic x-y tests on Al and Cu show that the strain hardening coefficient decreases after each change. DOE

N86-29034# Sandia National Labs., Albuquerque, N. Mex.
SOLUTE TRAPPING IN ION-IMPLANTED METALS
S. M. Myers, D. M. Follstaedt, and F. Besenbacher 1985 80 p Presented at the ASM Metals Congress/TMS-AIME Fall Meeting, Toronto, Ontario, 13 Oct. 1985 Prepared in cooperation with Aarhus Univ., Denmark
(Contract DE-AC04-76DP-00789)
(DE86-003722; SAND-85-1808C; CONF-8510160-11) Avail: NTIS HC A05/MF A01

Solutes in metals undergo trapping reactions with numerous entities that range from irradiation defects to the boundaries of precipitates. Such trapping is especially prevalent in ion-implanted alloys because of the high defect densities, refine microstructures, relatively low formation temperatures and frequent use of interstitial solutes that typify these systems. Solute concentrations as high as several atomic percent may be involved; consequently, the effects upon microstructure and macroscopic properties are often substantial. This review begins with a general and qualitative discussion of trapping behavior, and then moves to a more detailed consideration of the theoretical methods used to treat these effects. With this backgound, selected experimental studies are presented to develop general trends and to illustrate the experimental and theoretical procedures. The discussion concludes by considering implications of solute trapping for the microstructures and properties of ion-implanted alloys. DOE

N86-29035# Los Alamos National Lab., N. Mex.
DEVELOPMENT OF A MOLYBDENUM-RHENIUM ALLOY FOR SPACE NUCLEAR REACTORS
L. B. Lundberg 1986 30 p Presented at the 115th American Institute of Mining, Metallurgical and Petroleum Engineers Annual Meeting, New Orleans, La., 2 Mar. 1986
(Contract W-7405-eng-36)
(DE86-006034; LA-UR-86-304; CONF-860340-2) Avail: NTIS HC A03/MF A01

Information is presented on the fabrication, properties, and use of molybdenum-rhenium alloys for space nuclear reactors. DOE

N86-29036# Argonne National Lab., Ill.
LABORATORY STUDY OF CORROSION OF HIGH-TEMPERATURE ALLOYS/COATINGS IN SIMULATED MEDIUM Btu GAS ATMOSPHERES Final Report
K. Natesan Feb. 1986 58 p
(Contract W-31-109-eng-38)
(DE86-007948; EPRI-AP-4452) Avail: NTIS HC A04/MF A01

Laboratory experiments have been conducted to evaluate the relative corrosion resistance of several metallic materials and coated alloys after exposure to high-temperature gaseous atmospheres typical of those in a medium-Btu gasification process. Based on the results from 1000-h exposures with and without simulated condensate formation during downtime, it was concluded that low-alloy ferritic steel will exhibit metal recession rates up to 1.2 mmy(-1) at a metal temperature of 420(0)C. Under similar conditions, high-chromium austenitic alloys had recession rates up to 0.11 mmy(-1), while the coated alloys exhibited negligible attack over the time span of the present investigation. DOE

N86-29037# Societe Nationale Industrielle Aerospatiale, Paris (France).
THE FUTURE OF SURFACE TREATMENTS IN AERONAUTICAL CONSTRUCTION [L'AVENIR DES TRAITEMENTS DE SURFACE EN CONSTRUCTION AERONAUTIQUE]
G. Sertour 29 Oct. 1985 8 p In FRENCH
(SNIAS-861-551-101; DCQ-1/85; ESA-86-97176) Avail: NTIS HC A02/MF A01

Surface treatments employed in the aeronautical industry and their evolution trends are presented. Aluminum or titanium alloy protection by electrolytic deposits, anodization, and vacuum or plasma deposits; the surface treatment of composite materials by paint or metallization; and the corrosion protection of refractory alloys by vapor phase diffusion of aluminum or chrome are considered. Fretting corrosion is shown to remain an unsolved problem related to several degradation and fatigue phenomena. ESA

N86-29038# Pacific Northwest Lab., Richland, Wash.
MEASUREMENT AND PREDICTION OF SENSITIZATION DEVELOPMENT IN AUSTENITIC STAINLESS STEELS
S. M. Bruemmer, L. A. Charlot, and D. G. Atteridge Oct. 1985 27 p Presented at the 13th Water Reactor Safety Meeting, Washington, D.C., 24 Oct. 1985
(Contract DE-AC06-76RL-01830)
(TI86-002819; PNL-SA-13423; CONF-8510173-35) Avail: NTIS HC A03/MF A01

The effects of thermal and thermomechanical treatments on sensitization development in Type 304 and 316 stainless steels have been measured and compared to model predictions. Sensitization development resulting from isthermal, continuous cooling and pipe welding treatments has been evaluated. An empirically-modified, theoretically-based model is shown to accurately predict material degree of sensitization (DOS) as expressed by the electrochemical potentiokinetic reactivation (EPR) test after both simple and complex treatments. Material DOS is also examined using analytical electron microscopy to document grain boundary chromium depletion and is compared to EPR test results. Author

N86-29245# Army Materials and Mechanics Research Center, Watertown, Mass. Physical Metallurgy Branch.
DIRECTION OF R AND D AND CURRENT STATUS OF UNDERSTANDING OF ADVANCED GEAR STEELS
P. J. Fopiano, J. E. Krzanowski, and G. M. Crawford *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 15 p (For primary document see N86-29236 20-37)
Avail NTIS HC A11/MF A01

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

N86-29039* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
PROCESS FOR PREPARING ESSENTIALLY COLORLESS POLYIMIDE FILM CONTAINING PHENOXY-LINKED DIAMINES Patent
Anne K. StClair and Terry L. StClair Issued 17 Jun. 1986 8 p Filed 23 Aug. 1984 Supersedes N85-20128 (23 - 11, p 1611)
(NASA-Case-LAR-13353-1; US-Patent-4,595,548;
US-Patent-Appl-SN-643524; US-Patent-Class-264-236;
US-Patent-Class-264-204; US-Patent-Class-264-216;
US-Patent-Class-264-347; US-Patent-Class-528-222;
US-Patent-Class-528-341; US-Patent-Class-528-183) Avail: US Patent and Trademark Office CSCL 11C

A polyimide film that is approximately 90% transparent at 500 nm, useful for thermal protective coatings and solar cells, and the processes for preparing the same by thermal and chemical conversion are disclosed. An essential feature for achieving maximum optical transparency films requires utilizing recrystallized and/or sublimated specific aromatic diamines and dianhydride monomers and introducing phenoxy or thiophenyl separator groups and isomeric m,m' or o,p'-oriented diamines into the polymer molecular structure. The incorporation of these groups in the polymer structure serves to separate the chromaphoric centers and reduce the formation of inter-chain and intra-chain charge transfer complexes which normally cause absorptions in the UV-visible range. The films may be obtained by hand, brushing, casting, or spraying a layer of polyamic acid solutions onto a surface and thermally converting the applied layer to the polyimide, or the polyamic acid solution can be chemically converted to the polyimide, subsequentially dissolved in an organic solvent, and applied as a polyimide film layer with the solvent therein thermally removed. Author

N86-29040*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NUMERICAL MODELING OF PHYSICAL VAPOR TRANSPORT IN A VERTICAL CYLINDRICAL AMPOULE, WITH AND WITHOUT GRAVITY
Timothy L. Miller Jul. 1986 21 p
(NASA-TP-2620; NAS 1.60:2620) Avail: NTIS HC A02/MF A01 CSCL 20D

Numerical modeling has been performed of the fluid dynamics in a prototypical physical vapor transport crystal growing situation. Cases with and without gravity have been computed. Dependence of the flows upon the dimensionless parameters aspect ratio and Peclet, Rayleigh, and Schmidt numbers is demonstrated to a greater extent than in previous works. Most notably, it is shown that the effects of thermally-induced buoyant convection upon the mass flux on the growth interface crucially depend upon the temperature boundary conditions on the sidewall (e.g., whether adiabatic or of a fixed profile, and in the latter case the results depend upon the shape of the profile assumed). Author

N86-29041*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STRUCTURE-TO-PROPERTY RELATIONSHIPS IN ADDITION CURED POLYMERS 2: RESIN Tg COMPOSITE INITIAL MECHANICAL PROPERTIES OF NORBORNENYL CURED POLYIMIDE RESINS
William B. Alston 1986 13 p To be presented at the 18th National SAMPE Technical Conference, Seattle, Washington, 7-9 Oct. 1986
(NASA-TM-88794; E-2979; NAS 1.15:88794; USAAVSCOM-TR-86-C-22) Avail: NTIS HC A02/MF A01 CSCL 11C

PRM (polymerization of monomeric reactants) methodology was used to prepare thirty different polyimide oligomeric resins. Monomeric composition as well as chain length between sites of crosslinks were varied to examine their effects on glass transition temperature (Tg) of the cured/postcured resins. An almost linear correlation of Tg versus molecular distance between the crosslinks was observed. An attempt was made to correlate Tg with initial mechanical properties (flexural strength and interlaminar shear strength) of unidirectional graphite fiber composites prepared with these resins. However, the scatter in mechanical strength data prevented obtaining as clear a correlation as was observed for the structural modification/crosslink distance versus Tg. Instead, only a range of composite mechanical properties was obtained at the test temperatures studied (room temperature, 288 and 316 C). Perhaps more importantly, what did become apparent during the attempted correlation study was: (1) that PMR methodology could be used to prepare composites from resins that contain a wide variety of monomer modifications, and (2) that these composites almost invariably provided satisfactory initial mechanical properties as long as the resins selected were melt processable. Author

N86-29042*# Southwest Research Inst., San Antonio, Tex.
SLIDING SEAL MATERIALS FOR ADIABATIC ENGINES, PHASE 2 Interim Report, Feb. 1985 - Feb. 1986
James Lankford and William Wei Apr. 1986 54 p
(Contracts DEN3-352; DE-AI01-86CE-50162)
(NASA-CR-179475; DOE/NASA/0352-2; NAS 1.26:179475; Rept-06-7963) Avail: NTIS HC A04/MF A01 CSCL 11B

An essential task in the development of the heavy-duty adiabatic diesel engine is identification and improvements of reliable, low-friction piston seal materials. In the present study, the sliding friction coefficients and wear rates of promising carbide, oxide, and nitride materials were measured under temperature, environmental, velocity, and loading conditions that are representative of the adiabatic engine environment. In addition, silicon nitride and partially stabilized zirconia disks were ion implanted with TiNi, Ni, Co, and Cr, and subsequently run against carbide pins, with the objective of producing reduced friction via solid lubrication at elevated temperature. In order to provide guidance needed to improve materials for this application, the program stressed fundamental understanding of the mechanisms involved in friction and wear. Electron microscopy was used to elucidate the micromechanisms of wear following wear testing, and Auger electron spectroscopy was used to evaluate interface/environment interactions which seemed to be important in the friction and wear process. Unmodified ceramic sliding couples were characterized at all temperatures by friction coefficients of 0.24 and above. The coefficient at 800 C in an oxidizing environment was reduced to below 0.1, for certain material combinations, by the ion implanation of TiNi or Co. This beneficial effect was found to derive from lubricious Ti, Ni, and Co oxides. Author

N86-29043# University of Southern California, Los Angeles. Dept. of Chemistry.
THE INFLUENCE OF SUB Tg ANNEALING ON THE PROPERTIES OF POLYMERS ABOVE AND BELOW Tg Final Report, 1 Mar. 1983 - 28 Feb. 1985
John J. Aklonis 10 Dec. 1985 134 p
(Contract DAAG29-83-K-0034)
(AD-A165899; ARO-19566.1-CH) Avail: NTIS HC A07/MF A01 CSCL 11/2

One of the fundamental tenets of all kinetic treatments of the glass transitions is that changes in viscosity occur as glasses age or anneal below the glass transition temperature even under isothermal conditions. To explain these experimental results it is necessary to assume that these changes are large, i.e, orders of magnitude under ordinarily employed experimental conditions. However, since the viscosity of glasses is always so high, (these materials are solids) even such large changes in the viscosity can go undetected. To probe these predicted large viscosity variations, we investigated changes in the effective local or micro viscosity of polymeric glasses doped with fluorescent dye molecules at very low concentrations. We reasoned that changes in viscosity of the glass will influence the local environment of the dye molecules and will be reflected as changes in rotational relaxation times or tumbling rates of the dye. These can be measured by monitoring the polarization of fluorescence emission of the dye molecules. We have investigated changes in fluorescence depolarization associated with thermal aging of several polymer glasses. Our results are much different than what has been observed earlier where the optical experiments were done at room temperature. We have concluded that, in the previous work, macroscopic orientation of the samples was induced via the severe quenching conditions and that the unexpected extremes of time and temperature necessary to erase the influence of sub Tg annealing, were, in fact, associated with relaxation of this microscopic ordering. GRA

N86-29044# Rutgers - The State Univ., New Brunswick, N. J. Dept. of Ceramics.
LOCAL STRUCTURE OF METAL ATOMS IN SILICA AND SILICATES Progress Report, May 15 - 1 Dec. 1985
S. H. Garofalini Dec. 1985 7 p
(Contract DE-FG05-84ER-45078)
(DE86-004998; DOE/ER-45078/1-1985) Avail: NTIS HC A02/MF A01

This research is aimed at developing a better understanding of the structural and dynamic properties of metal atoms in vitreous silica and at the vitreous silica surface. The major avenues of research have addressed: the structure of the vitreous silica surface and the effect of that structure on the adsorption behavior, structure, and mobility of atoms adsorbed onto the vitreous silica surface, and the local structure around zinc ions in zinc silicate glasses and sodium zinc silicate glasses and the effect of that structure on diffusion. DOE

N86-29045# Technical Research Centre of Finland, Espoo.
EFFECT OF FUEL OIL ADDITIVES. A LITERATURE AND QUERY STUDY
M. Jantunen May 1985 41 p In FINNISH
(DE86-750279; VTT-TIED-451) Avail: NTIS (US Sales Only) HC A03/MF A01

An abundance of different additives is available for boosting the use of light and heavy fuel oils. This literature review

concentrates on the additives that affect the combustion and phenomena following it. Additives that affect the processability and storability of fuel oil are not discussed. Certain alkaline, alkali earth and transition elemental metals have proved to be effective combustion boosters. Differences in efficiency are great and depend on the metal concentration and on the compound, in which the material is mixed with oil. Part of compounds are water-soluble, part oil-soluble, and sometimes the material is sprayed as a powder direct into the flame. The particulate amount developed in the combustion of heavy oils can usually be reduced with the aid of additives. As regards light oils, the procedure is not as clear: the particulate emissions are usually not reduced, rather the contrary: they may even be increased as a consequence of the additive application. A query was also sent to 300 power plants fired with heavy fuel oil to collect experience from the use of additives. The results were in conformity with those obtained in Sweden and in the United States. Of the 222 plants that answered, 84 informed to have tested or to use some additive. In 58 cases the additive was still in use. Reduction in sooting, improved combustion and facilitation of cleaning were the most general reasons for the use of additives. This aim was considered to have been achieved in a third of the experiments, but only in a few cases were there measuring results to confirm this opinion. The economy of the additive application is often based on availability and service factors, and so it is difficult to carry out generally tenable calculations. The evaluation of the economy of combustion boosters is based on the possibility of reducing flue gas losses.
DOE

N86-29046# Brookhaven National Lab., Upton, N. Y.
USE OF POLYACRYLIC ACID MACROMOLECULES TO IMPROVE STIFFNESS AND ADHESIVE BOND DURABILITY OF ZINC PHOSPHATE CONVERSION PRECOATINGS
T. Sugama and L. E. Kukacka Nov. 1985 16 p Presented at the Tri-service Corrosion Conference, Orlando, Fla., 5 Dec. 1985
(Contract DE-AC02-76CH-00016)
(DE86-006237; BNL-37381; CONF-851263-1) Avail: NTIS HC A02/MF A01

The electrostatic internal diffusion and segmental chemisorption of polyelectrolyte macromolecules, either on newly precipitated crystal nuclei or on crystal growth sites during primary zinc phosphate (Zn.Ph) conversion processes applied to cold-rolled steel surfaces, contribute significantly to the controllability of the Zn.Ph crystal dimensions. This results in an improvement in the stiffness and ductility of the normally brittle Zn.Ph layers. The polymer-polymer chemical bonding, produced at the polymer topcoat-to-polyelectrolyte-Zn.Ph precoat interfacial joints, plays a key role in achieving a long-term bond durability of the metal-adhesive joints upon exposure to chemically corrosive environments.
DOE

N86-29047# Sandia National Labs., Albuquerque, N. Mex.
EFFECTS OF ION BOMBARDMENT IN PLASMA POLYMERIZATION
R. J. Buss 1986 10 p Presented at the Materials Research Society Spring Meeting, Palo Alto, Calif., 15 Apr. 1986
(Contract DE-AC04-76DP-00789)
(DE86-007702; SAND-85-2350C; CONF-860445-1) Avail: NTIS HC A02/MF A01

A molecular beam probe technique has been used to investigate the role of ion bombardment of the film surface during the plasma polymerication process. Thin films have been deposited in a vacuum chamber from a molecular beam containing all the plasma species and these were compared with similar deposits from a beam with the charged particles deflected away. A comparison was made of deposition rates, vis/UV and IR absorption spectra of the films. It was found that the deposition rate was increased 20% with the elimination of ion bombardment. Ions incident on the film surface during deposition cause a net ablation of the film. The ion bombardment also causes an increased absorption of UV and near-UV light by the film resulting in a noticeable yellowing. No change was observed in the IR spectra of the films with ion deflection.
DOE

N86-29048# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France). Div. Systemes Balistiques et Spatiaux.
WINDING OF CONTINUOUS FILAMENTS IMPREGNATED WITH THERMOPLASTIC RESINS [BOBINAGE DE FIBRES CONTINUES IMPREGNEES DE RESINE THERMOPLASTIQUE]
J. L. Tisne 4 Jan. 1986 26 p In FRENCH Presented at Journees Europeennes des Composites, Paris, France, 4 Mar. 1986
(SNIAS-861-430-110; ESA-86-97172) Avail: NTIS HC A03/MF A01

The development status, manufacturing procedures and properties of thermoplastic matrix composites are described. The evaluation is based on experimental tests of commercial materials intended for aerospace applications. The materials tested include polyester, polyamide, polyimide, and polyether matrices. The commercial products are glass, kevlar or carbon filaments presented as ribbons impregnated with the resin. It is shown that many applications are already in development. The advantages and problems are discussed.
ESA

N86-29049# Centre d'Essais Aeronautique Toulouse (France). Lab. d'Etudes Materiaux non Metalliques.
EVALUATION OF PHYSICAL AND PHYSICAL CHEMICAL METHODS FOR THE CHARACTERIZATION OF CARBON FIBERS [EVALUATION DE METHODES DE CARACTERISATION PHYSIQUE ET PHYSICO-CHIMIQUE DES FIBRES DE CARBONE]
1985 38 p In FRENCH
(PV-M2-697500; ESA-86-97193) Avail: NTIS HC A03/MF A01

X-ray diffraction, chemical analysis, and electronic microscopy methods were studied in order to improve acceptance inspection procedures of preimpregnated carbon fibers. The chemical analysis is carried out after combustion of the washed fibers in an oxygen atmosphere. It is shown that the nitrogen content varies with the fiber origin. Values of 3.5% to 6% are found. Electron microscope photographs show differences related to the fiber manufacturing process. The X-ray diffraction experiments show broadening of the OO2 interference peak which characterizes each type of fiber. The statistical dispersion of this parameter is sufficiently low to promote the test as a fast quality control procedure.
ESA

N86-29242# Boeing Vertol Co., Philadelphia, Pa.
A STUDY OF THE POTENTIAL BENEFITS ASSOCIATED WITH THE DEVELOPMENT OF A DEDICATED HELICOPTER TRANSMISSION LUBRICANT
Raymond J. Drago, Pasquale J. Mangione (Naval Air Propulsion Test Center, Trenton, N.J.), and Raymond D. Wendrzycki *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 11 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

N86-29244# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
REQUIREMENTS ON LUBRICATIN OIL FROM THE VIEW OF A HELICOPTER MANUFACTURER
Joachim Hartmann and Wolfgang Jonda *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 6 p (For primary document see N86-29236 20-37)
Avail NTIS HC A11/MF A01

N86-29249# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
MILITARY AIRCRAFT PROPULSION LUBRICANTS: CURRENT AND FUTURE TRENDS
G. A. Beane, IV, Lois J. Gschwender, Carl E. Snyder, Jr., and John T. Shimski (Naval Air Propulsion Test Center, Trenton, N.J.) *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 16 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

N86-29250# Imperial Coll. of Science and Technology, London (England).
FUTURE TRENDS IN HELICOPTER TRANSMISSION LUBRI-

CANTS
H. A. Spikes *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 10 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

N86-29251# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
AIRCRAFT ENGINE OILS AND THEIR BEHAVIOUR AT HIGH TEMPERATURES
K. Maier *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 12 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

N86-29252# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
PERFORMANCE MODELLING: A TOOL FOR LUBRICANT DEVELOPMENT
Howard E. Bandow *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 11 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

N86-29253# Technische Univ., Munich (West Germany).
SCORING TESTS OF AIRCRAFT TRANSMISSION LUBRICANTS AT HIGH SPEEDS AND HIGH TEMPERATURES
H. Winter and K. Michaelis *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 9 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; storage and handling; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N86-29050# Texas A&M Univ., College Station. Mechanics and Materials Center.
DYNAMIC FRACTURE AND DEFORMATION OF SOLID PROPELLANT Final Report, Feb. 1983 - Mar. 1986
R. A. Schapery and J. R. Walton Mar. 1986 7 p
(Contract N00014-83-K-0211)
(AD-A166424; MM-4867-86-10) Avail: NTIS HC A02/MF A01 CSCL 21/9

Contributions to two distinct but related topics have been made: (1) high speed crack growth in linear viscoelastic media, and (2) nonlinear viscoelastic constitutive equations for particle-filled rubber with microcracks. Both are relevant to the dynamic mechanical response of solid propellant. Work was completed and published on the dynamic steady-state propagation of an antiplane shear crack in a general linear viscoelastic layer. An infinite series representation for the stress intensity factor was derived, each term of which can be calculated recursively in closed-form. A simple, universal dependence upon crack speed and basic material properties was found. These results represent a significant step in understanding the influence of a physical dimenson (the layer thickness) on dynamic stresses in the neighborhood of crack tips in rate-dependent materials. Another paper is partly a summary of principal results in 1 and 3 and contains new material not published elsewhere. Specifically, the analysis of 3 was extended to derive the full stress field in the body. A much simpler form than was presented in 3 for the entire stress field ahead of and in the plane of the crack was exhibited and the angular dependence of the local stress field at the crack tip was calculated. GRA

N86-29051# Brobeck (William M.) and Associates, Berkeley, Calif.
ENGINEERING SUPPORT FOR LLNL CHEMISTRY'S HIGH EXPLOSIVE TECHNOLOGY GROUP Final Report
A. M. Weston and E. James Dec. 1985 22 p
(Contract W-7405-eng-48)
(DE86-006722; UCRL-15761) Avail: NTIS HC A02/MF A01

Support for the Lawrence Livermore National Laboratory (LLNL) High Explosive Technology (HET), part of the Chemistry Division is described. Brief progress reports are presented for the following six tasks: (1) assess mechanical and explosive response of proposed extreme environmental weapon systems; (2) perform a hazard study relating to Trident D-5 motor response; (3) continue development and application of the deflagration to detonation (DDT) computer model (code RDUCT) for the hazard assessment for rocket propellants (HARP) program; (4) perform rocket motor vulnerability calculations for a proposed new air force mobile missile; (5) perform additional analyses relating to radioisotope thermo-electric generator PuO2 containment with possible NASA space shuttle accident scenarios; and (6) develop a relational data base for information pertinent to the hazard studies relating to the Trident D-5 motor response and the associated HARP program. DOE

N86-29052# Mueller Associates, Inc., Baltimore, Md.
ADVANCED PROPULSION SYSTEMS AND ALTERNATIVE FUELS FOR NON-HIGHWAY TRANSPORTATION. VOLUME 1: AN ASSESSMENT OF UNIQUE AND PRIORITY RESEARCH AND DEVELOPMENT OPPORTUNITIES Final Report
Jan. 1986 12 p
(Contract DE-AC01-84ER-30063)
(DE86-006115; DOE/ER-30063/T4) Avail: NTIS HC A02/MF A01

Based upon earlier prioritization and assessment analyses, a selection of R and D needs were identified for non-highway transportation. The Department of Energy's Office of Program Analysis (DOE-OPA) in recognizing the likelihood of only limited federal government monetary support of non-highway R and D, requested that these R and D needs be further prioritized to a limited number (four to six) of recommendations. This paper presents the logic and rationale for arriving at this much smaller set of R and D priorities and re-summarizes the specific R and D needs and their potential benefits and/or utility. DOE

N86-29053# Mound Lab., Miamisburg, Ohio.
MOUND CALORIMETRY FOR EXPLOSIVE SURVEILLANCE
G. C. Shockey and W. W. Rodenburg 1985 12 p Presented at the Joint DOD-DOE Explosives Surveillance Meeting, Albuquerque, N. Mex., 3 Dec. 1985
(Contract DE-AC04-76DP-00053)
(DE86-006143; MLM-3327(OP); CONF-851256-6) Avail: NTIS HC A02/MF A01

Heat of reaction determinations of pyrotechnics and explosives is made at MRC-Mound by bomb calorimetry. Energy releases from ten calories to 94 kilocalories have been measured accurately using four different calorimeter systems. Each system is described and some heat of reaction results are given. DOE

N86-29054# Oak Ridge National Lab., Tenn.
APPLICATION OF MINIMAL QUALITY COAL LIQUIDS TO DIESEL ENGINES
R. L. Graves and E. C. Fox 1986 13 p Presented at the DOE New Fuel Forms Workshop, Washington, D.C., 25 Feb. 1986
(Contract DE-AC05-84OR-21400)
(DE86-007864; CONF-860271-1) Avail: NTIS HC A02/MF A01

Experiments and studies of low-temperature coal pyrolysis were performed by ORNL to evaluate the quality of the raw coal liquids and the economic advantages of a simple process capable of producing usable liquid and solid products. Raw oils generated by low-temperature coal pyrolysis were chemically characterized, blended with No. 2 diesel (20 to 25% by volume), and tested in three diesel engines of different configurations. Determination of physical and chemical properties of the pyrolysis liquids indicated a higher hydrogen/carbon ratio and lower aromatic content than typical SRC II and EDS middle distillates. The combustion tests, which were performed in both direct and indirect-injection engines, had variable results. In some cases there was no effect on emissions and performance; in others, emissions were reduced in one engine, and increased in another. The results of these tests

are brought into perspective with a general discussion of diesel engine design considerations and the results of coal liquid test by other. DOE

N86-29064# Ballistic Research Labs., Aberdeen Proving Ground, Md.
LIQUID PROPELLANT GUN TECHNOLOGY
W. F. Morrison, J. D. Knapton, and P. G. Baer *In* AGARD Interior Ballistics of Guns Jan. 1986 16 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

N86-29065# Royal Armament Research and Development Establishment, Fort Halstead (England).
INGNITION, COMBUSTION, AND PHYSICAL PROPERTIES OF LIQUID PROPELLANTS AT GUN PRESSURES
G. G. Cook and T. O. Andrews *In* AGARD Interior Ballistics of Guns Jan. 1986 13 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

N86-29066# Fraunhofer-Inst. fuer Kurzzeitdynamik, Weil am Rhein (West Germany). Abteilung fuer Ballistik.
MECHANICAL BEHAVIOUR OF PROPELLANT GRAINS UNDER HEAVY DYNAMIC LOAD
Gerd Zimmerman *In* AGARD Interior Ballistics of Guns Jan. 1986 15 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

N86-29067# Bombrini Parodi-Delfino S.p.A., Rome (Italy).
FIELD ARTILLERY GUN PERFORMANCES RELATED TO TRIPLE-BASE POWDER QUALITY
B. DAndrea, M. Petrucci, and M. DiLorenzo *In* AGARD Interior Ballistics of Guns Jan. 1986 15 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

N86-29073# Etablissement Technique de Bourges (France).
EXPERIMENTAL STUDY OF THE IGNITION OF EXPLOSIVE CHARGES USING VISUALIZATION OF THE PHENOMENA [ETUDE EXPERIMENTALE DE LALLUMAGE DUNE CHARGE PROPULSIVE PAR VISUALISATION DU PHENOMENE]
Claude Berthommier *In* AGARD Interior Ballistics of Guns Jan. 1986 7 p In FRENCH (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

N86-29077# Dynamit Nobel A.G., Fuerth (West Germany). Dept. of Research and Development-Ammunition.
IGNITION OF HIGH-PERFORMANCE GUN AMMUNITION
Horst Penner *In* AGARD Interior Ballistics of Guns Jan. 1986 7 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; and cryogenics.

N86-29055* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANGULAR MEASUREMENT SYSTEM Patent
James R. Currie and Ralph R. Kissel Issued 10 Jun. 1986 6 p Filed 3 Oct. 1984 Supersedes N85-20298 (23 - 11, p 1635)
(NASA-Case-MFS-25825-1; US-Patent-4,594,540; US-Patent-Appl-SN-657309; US-Patent-Class-318-661; US-Patent-Class-340-347SY; US-Patent-Class-340-347CC; US-Patent-Class-318-636; US-Patent-Class-318-605) Avail: US Patent and Trademark Office CSCL 13B

A system for the measurement of shaft angles is disclosed wherein a synchro resolver is sequentially pulsed, and alternately, a sine and then a cosine representative voltage output of it are sampled. Two like type, sine or cosine, succeeding outputs (V sub S1, V sub S2) are averaged and algebraically related to the opposite type output pulse (V sub c) occurring between the averaged pulses to provide a precise indication of the angle of a shaft coupled to the resolver at the instant of the occurrence of the intermediately occurring pulse (V sub c). Author

N86-29056# Factory Mutual Research Corp., Norwood, Mass.
SPRAY COOLING IN ROOM FIRES
Hong-Zeng You, Hsiang-Cheng Kung, and Zhanxian Han Jul. 1986 45 p
(Grant NB83NADA4054)
(NBS-GCR-86-515) Avail: NTIS HC A03/MF A01

A series of 25 fire tests was conducted to investigate cooling in room fires by sprinkler spray. The tests were conducted in a 3.66 m x 7.32 m x 2.44 m high test room, which had a 1.22 m x 2.44 m high opening centered in one of the 3.66 m walls. The fire source was a spray fire with constant heptane flow rate, located opposite the room opening. In each test only one sprinkler was installed at the ceiling. Three geometrically similar sprinklers with nozzle diameters of 11.1 mm, 8.36 mm, and 6.94 mm were tested. Convective heat loss rate through the room opening was measured with a large fire products collector. The total heat release rate of the fire was derived from the fire products collector measurements using a carbon balance method. Heat loss rate to the ceiling and walls was measured, as well as radiative loss through the opening. Empirical correlations for the heat absorption rate of the spray and the convective heat loss rate through the room opening were established in terms of: (1) total heat release rate of the fire; (2) heat loss rate to the ceiling, walls, and floor, and radiative heat loss rate through the room opening; (3) room opening area and height; (4) sprinkler discharge rate; (5) water pressure; and (6) sprinkler orifice diameter. These correlations accounted for the effects of room geometry and opening size. Experimental results obtained for a different room geometry also followed these correlations. Author

N86-29057# Massachusetts Inst. of Tech., Lexington.
DISTANCE DETERMINATION VIA TRIANGULATION
Laurence G. Taff 11 Feb. 1986 27 p
(Contract F19628-85-C-0002)
(AD-A165932; TR-741; ESD-TR-85-303) Avail: NTIS HC A03/MF A01 CSCL 08/5

This report investigates the feasibility of distance determination by triangulation for artificial satellites, rockets, and so forth. The two-observer case is solved analytically and investigated in detail with respect to the propagation of errors. For objects distant compared to the observer to observer distance Delta rho, the variance of the observer-to-object distance R is given by Sigma sub R approx = (Sigma(R-squared))((csc theta)-squared)/Delta rho. Sigma is the standard deviation of the angular measurements, and theta is the angle between the observer-to-observer baseline and the direction to the object. The next topic discussed is the use of multiple, simultaneous, direction determinations for triangulation. A novel method is proposed to deal with this problem. It is extended to include observations with different measurement precision, and generalized to take into account the expanding conical nature of angular errors. Finally, some data acquired at the Experimental Test System of the GEODSS network and the Millstone Hill Radar are analyzed within this context. It is clear that there now exists a powerful observational tool to aid in initial orbit determination utilizing coordinated angles-only sensors. GRA

N86-29058# Argonne National Lab., Ill.
PROCEEDINGS OF THE 3RD SYMPOSIUM ON ENERGY ENGINEERING SCIENCES. THERMOFLUIDS AND SOLID MECHANICS
1985 277 p Symposium held at University Park, Pa., 8 Oct. 1985
(Contract W-31-109-eng-38)
(DE86-005973; CONF-8510176) Avail: NTIS HC A13/MF A01

The symposium reported on offered sessions on turbulence, solid mechanics and structures, turbulent heat transfer, combustion,

heterogeneous fluids and fluid mixtures, fracture mechanics and damage, transport phenomena in solids, tribology, jets and external flows. Separate abstracts were prepared for 32 papers in these symposium proceedings. DOE

N86-29059# Argonne National Lab., Ill.
FLUID FLOW AND HEAT TRANSFER MODELING FOR CASTINGS
H. M. Domanus, Y. Y. Liu, and W. T. Sha 1986 16 p Presented at the Modeling and Control of Casting and Welding Processes Conference, Santa Barbara, Calif., 12 Jan. 1986
(Contract W-31-109-eng-38)
(DE86-007999; CONF-860132-2) Avail: NTIS HC A02/MF A01

Casting is fundamental to manufacturing many types of equipment and products. Although casting is a very old technology that has been in existence for hundreds of years, it remains a highly empirical technology, and production of new castings requires an expensive and time-consuming trial-and-error approach. In recent years, mathematical modeling of casting has received increasing attention; however, a majority of the modeling work has been in the area of heat transfer and solidification. Very little work has been done in modeling fluid flow of the liquid melt. This paper presents a model of fluid flow coupled with heat transfer of a liquid melt for casting processes. The model to be described in this paper is an extension of the COMMIX code and is capable of handling castings with any shape, size, and material. A feature of this model is the ability to track the liquid/gas interface and liquid/solid interface. The flow of liquid melt through the sprue and runners and into the mold cavity is calculated as well as three-dimensional temperature and velocity distributions of the liquid melt throughout the casting process. DOE

N86-29060# Kernforschungszentrum, Karlsruhe (West Germany).
GERMAN-FRENCH STRATEGY FORUM. INFORMATION TECHNOLOGY. REPORT OF THE GERMAN WORKING GROUP PRODUCTION ENGINEERING 1984/1985 [DEUTSCH-FRANZOESISCHES STRATEGISCHES FORUM INFORMATIONS-TECHNIK. BERICHT DER DEUTSCHEN ARBEITSGRUPPE FERTIGUNGSTECHNIK]
D. Stams Nov. 1985 315 p Partly in ENGLISH, GERMAN, and FRENCH Sponsored by Bundesministerium fuer Forschung und Technologie
(KfK-PFT-113; ESA-86-96908) Avail: NTIS HC A14/MF A01

Production engineering activities in Germany and France, and the possibilities of cooperation are reported on. Robotics, CAD, and local area networks are discussed. Proposals for the European advanced technology program EUREKA are given. ESA

N86-29061# Office of Technology Assessment, Washington, D.C.
BALLISTIC MISSILE DEFENSE TECHNOLOGIES
Sep. 1985 334 p
(PB86-182961; OTA-ISC-254; LC-85-600586) Avail: NTIS HC A15/MF A01 CSCL 15C

A report on Ballistic Missile Technologies includes the following: Executive summary; Introduction; Ballistic missiles then and now; Deterrence, U.S. nuclear strategy, and BMD; BMD capabilities and the strategic balance; Crisis stability, arms race stability, and arms control issues; Ballistic missile defense technologies; Feasibility; Alternative future scenarios; Alternative R&D programs. GRA

N86-29062# Office of Technology Assessment, Washington, D.C.
STRATEGIC MATERIALS: TECHNOLOGIES TO REDUCE US IMPORT VULNERABILITY
May 1985 413 p
(TI86-900760; OTA-ITE-248) Avail: NTIS HC A18/MF A01

Three nations, South Africa, Zaire, and the U.S.S.R., account for over half of the world's production of chromium, cobalt, manganese, and platinum group metals. These metals are essential in the production of high-temperature alloys, steel and stainless steel, industrial and automotive catalysts, electronics, and other applications that are critical to the U.S. economy and the national defense. With minor exceptions, there is no domestic mine production of any of the four metals. Government actions to assure secure supplies of metals critical to the United States have been limited largely to reliance on the national defense stockpile to ensure the availability of materials required for national defense in time of war, leaving it to the free market to provide a diversity of suppliers for the industrial economy. An overall strategy to reduce U.S. reliance on uncertain sources of supply of strategic materials should be based on a combination of three technical approaches: increase the diversity of the world supply of strategic metals through the development of promising deposits; decrease demand for strategic metals through the implementation of improved manufacturing processes and recycling of strategic materials from scrap and waste; and identify and test substitute materials for current applications and develop new materials with reduced strategic material content for future applications. Author

N86-29063# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Propulsion and Energetics Panel.
INTERIOR BALLISTICS OF GUNS
Loughton, England Jan. 1986 220 p Meeting held in Florence, Italy, 9-11 Sep. 1985; sponsored by the Propulsion and Energetics Panel
(AGARD-CP-392; ISBN-92-835-0388-0) Avail: NTIS HC A10/MF A01

Topics addressed include: liquid propellant guns; characteristics of solid gun propellants; gun barrel erosion; low vulnerability propellants for guns; experimental and test techniques in interior ballistics; gun ignition systems; new problems in guns; and traveling charge gun theory. For individual titles, see N86-29064 through N86-29078.

N86-29064# Ballistic Research Labs., Aberdeen Proving Ground, Md.
LIQUID PROPELLANT GUN TECHNOLOGY c28
W. F. Morrison, J. D. Knapton, and P. G. Baer *In* AGARD Interior Ballistics of Guns Jan. 1986 16 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

Research and development efforts on liquid propellant guns have increased steadily in the United States over the past five years as a result of progress in both liquid propellant and propulsion technology. The research program is directed toward the use of hydroxyl ammonium nitrate (HAN) based liquid monopropellants in a regenerative liquid propellant gun. The HAN-based liquid monopropellants offer a number of advantages over both solid propellants and other liquid propellant formulations. The regenerative process is based on the injection of propellant into the combustion chamber during the ballistic cycle. The interior ballistic process is summarized to provide a basis for the discussion of experimental gun firing data. A simple inline piston with multiple cylindrical injectors is used as an example. Regenerative investigation in the United States have focused on annular injection configurations, in which the propellant enters the chamber in the form of an annular sheet. A simple version of the configuration was built and tests in 25, 30, and 105 mm. Ballistic data are presented, along with discussions of ballistic repeatability and efficiency. Four computer models of the regenerative interior ballistic process are compared. Author

N86-29065# Royal Armament Research and Development Establishment, Fort Halstead (England).
IGNITION, COMBUSTION, AND PHYSICAL PROPERTIES OF LIQUID PROPELLANTS AT GUN PRESSURES c28
G. G. Cook and T. O. Andrews *In* AGARD Interior Ballistics of Guns Jan. 1986 13 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

The internal ballistics of a regenerative injection liquid propellant gun depend on the rate of injection of the liquid propellant rather than on the burning rate, owing to the small size of the droplets produced. The rate of injection is determined by the effect of the compressibility of the liquid on the motion of the piston and by its flow characteristics through the injector. The force constant of

the propellant is important as it determines the combustion pressure resulting from any given flow rate. A standard closed vessel was modified and used with a specially developed igniter to investigate the combustion of Otto Fuel II at gun pressure. It was also used to investigate the compressibility of inert liquid at pressures up to 600 MPa. A liquid propellant test vessel was constructed for use in the investigation of the compressibility of live liquids and the flow of liquids at high pressure. Author

N86-29066# Fraunhofer-Inst. fuer Kurzzeitdynamik, Weil am Rhein (West Germany). Abteilung fuer Ballistik.
MECHANICAL BEHAVIOUR OF PROPELLANT GRAINS UNDER HEAVY DYNAMIC LOAD c28
Gerd Zimmerman *In* AGARD Interior Ballistics of Guns Jan. 1986 15 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

Special test devices were constructed to simulate the dynamic forces on gun propellant grains during shots at ambient and low temperatures (-40 C). With these devices the dynamic stress at failure, the fragmentation type (pasty, brittle), and other correlated physical characteristics of several propellant types were measured. Conclusions are drawn for the propellant behavior under real gun conditions. Author

N86-29067# Bombrini Parodi-Delfino S.p.A., Rome (Italy).
FIELD ARTILLERY GUN PERFORMANCES RELATED TO TRIPLE-BASE POWDER QUALITY c28
B. DAndrea, M. Petrucci, and M. DiLorenzo *In* AGARD Interior Ballistics of Guns Jan. 1986 15 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

In order to achieve the best results in the 155-39 mm field field artiliary gun, several parameters affecting the triple-base powder quality were investigated. Mainly nitro-cellulose molecular weights (MW) and molecular weight distributions (MWD), determined by means of gel-permeation chromatography (GPC) related to the powder rheological properties are reported. In addition theoretical interior ballistic evaluations, tailored on powders manufactured with different nitrocellulose samples, based on computer program calculation, are compared with the firing test results. Author

N86-29068# Royal Military Coll. of Science, Shrivenham (England). School of Management and Mathematics.
PRESSURE WAVE: GUN BARREL INTERACTIONS c34
A. B. Crowley and W. P. C. King *In* AGARD Interior Ballistics of Guns Jan. 1986 11 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

The interaction of pressure waves generated during the internal ballistics cycle with the vibrations of a tank barrel, and the possible effects on accuracy, are described. The investigation is based on codes simulating the complete internal ballistics cycle, including the venting of gases after shot exit, and the longitudinal and flexural vibration modes of the barrel, both of which were developed at the Royal Military College of Science. The computative effects of pressure waves on both accuracy and structural integrity are discussed for a number of different charge and barrel configurations. Author

N86-29069# Royal Military Coll. of Science, Shrivenham (England).
BORE TEMPERATURE AND HEAT FLUX IN A 40 mm GUN BARREL
B. Lawton *In* AGARD Interior Ballistics of Guns Jan. 1986 12 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

A method of measuring the bore srface temperature fluctuation in a 40 mm gun is described. Fast response, 1 microsecond, eroding type, surface thermocouples are used and a feature is that they can tolerate up to 3 mm wear and pressures up to 2000 bar. The bore temperature is measured at three positions along the barrel and the pressure is measured at the breech. All three signals are captured using digital oscilloscopes and are transferred to a digital computer. The signals are processed to give instantaneous heat flux, shot velocity, shot travel, and total heat transfer. Gas leakage past the shot is found to be significant. A simple theory is proposed for calculating the maximum bore temperatures and the total heat transfer and this theory is confirmed by measurements on fourteen different rounds made up using three propellants and various charge masses and grain formulations. Author

N86-29070# Prins Maurits Lab. TNO, Rijswijk (Netherlands).
ON THE THERMAL BEHAVIOUR OF THE BARREL DURING THE INTERIOR BALLISTIC CYCLE OF PROPELLANT GUNS
W. J. Kolkert, M. Waas, and N. G. The *In* AGARD Interior Ballistics of Guns Jan. 1986 13 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

Thermal stress cycling during firing constitutes a major mechanism for erosion, wear, and fatigue in gun barrels and cannon tubes. In order to predict spatial and temporal temperature distributions at the inner envelope of and through the barrel and in the gas dynamic flow accompanying the interior ballistic cycle, a two-dimensional, quasi two-phase flow (turbulent, viscous, and compressible) model, was developed. A one-dimensional model treating radial heat conduction in the barrel was coupled to this flow model. Input parameters for these models were calculated with a one-dimensional, two-phase flow, burning routine, describing propellant deflagration. Besides a description of these models, results of a prediction got heat loss, projectile travel and pressure, temperature and flow velocity distributions in the gas dynamic flow, and temperature-time histories in the barrel wall are given for the interior ballistic cycle of a caliber .50in gun. Although predicted results for heat flow into and through the barrel and predicted temperature-time histories in the barrel cannot be compared with experimental results in a reliable way at this time, predicted results for pressure-time distributions and projectile-travel fit the experimental results in a promising way. Author

N86-29071# Ecole Royale Militaire, Brussels (Belgium). Dept. of Applied Chemistry.
INTERIOR BALLISTICS OF SMALL ARMS: PARTICULAR PROBLEMS. PART 1: HEAT TRANSFER AND COOK-OFF PHENOMEN IN A SMALL CALIBER WEAPON c34
R. Meysmans *In* AGARD Interior Ballistics of Guns Jan. 1986 10 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

The first results obtained since beginning in 1983 are summarized. Induction periods and critical temperature, measured during salvo-firing in a small caliber weapon are compared with the values theoretically predicted by means of a mathematical model, describing as correct as possible what happens in the combustion chamber. The determination of some physico-chemical parameters, to be used in the mathematical model, is discussed. Author

N86-29072# Ecole Royale Militaire, Brussels (Belgium). Dept. of Armament and Ballistics.
INTERNAL BALLISTICS OF SMALL ARMS: PARTICULAR PROBLEMS. PART 2: THERMODYNAMIC MODEL, POWDER PARAMETERS, INITIATION c34
E. Celens *In* AGARD Interior Ballistics of Guns Jan. 1986 23 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

The applicability of the thermodynamic model was studied in small caliber weapons. The use of appropriate computer algorithms for optimal exploitation of closed vessel trials was examined. To better understand the initiation phase, the working of primary high explosive compounds was studied by visualizing the ignition phenomenon in a transparent chamber. The results obtained in these studies are summarized. B.G.

N86-29073# Etablissement Technique de Bourges (France).
EXPERIMENTAL STUDY OF THE IGNITION OF EXPLOSIVE CHARGES USING VISUALIZATION OF THE PHENOMENA

[ETUDE EXPERIMENTALE DE LALLUMAGE DUNE CHARGE PROPULSIVE PAR VISUALISATION DU PHENOMENE] c28
Claude Berthommier *In* AGARD Interior Ballistics of Guns Jan. 1986 7 p In FRENCH (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

A three point visualization process was used to study the ignition and combustion phenomena of propulsive charges for large caliber ammunition. The visualization process was made possible by using a translucent sleeve as the barrel. The phenomena studied included the pressure, displacement and the speed of the flame front. The procedure studied made possible an examination of the ignition and combustion processes of various charge configurations. Two examples were studied; the first study pertained to a comparison of two igniter, and the second to a pre-programmed igniter. B.G.

N86-29074# Fraunhofer-Inst. fuer Kurzzeitdynamik, Weil am Rhein (West Germany). Abteilung fuer Ballistik.
MEASUREMENT OF IMPORTANT BALLISTIC FLOW PROPERTIES BY SPECTROSCOPIC TECHNIQUES c34
Guenter Klingenberg *In* AGARD Interior Ballistics of Guns Jan. 1986 18 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

Considerable progress was made in recent years in probing the gun interior ballistics cycle and the subsequent muzzle flow dynamics. With the amount of experimental research done, more detailed information was obtained to describe the many complexities of the flow phenomena which are associated with the discharge of a weapon. A survey of some of the experimental research is reviewed, pointing out the capabilities as well as the limitations and constraints encountered in ballistic environments. The experimental diagnostics described includes spectroscopic techniques for measuring the temperature and gas velocity in reacting two-phase flows produced by the combustion of both solid and liquid propellants. These techniques are the emission and/or absorption methods, reversal and Abel inversion methods, and laser Doppler spectrometry. In particular, an intrusive emission gauge technique is described which permitted the thermometric probing of optically thick propellant gases in highly pressurized combustion chambers. Sample results of these measurement will be presented. In addition, efforts directed towards the adequate simulation of reacting ballistic flows by mean of a gas gun simulator are described. Author

N86-29075# Concentration Heat and Momentum, Ltd., London (England).
MODELLING THE BEHAVIOUR OF ADDITIVES IN GUN BARRELS c34
N. Rhodes and J. C. Ludwig *In* AGARD Interior Ballistics of Guns Jan. 1986 11 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

A mathematical model which predicts the flow and heat transfer in a gun barrel is described. The model is transient, two-dimensional and equations are solved for velocities and enthalpies of a gas phase, which arises from the combustion of propellant and cartridge case, for particle additives which are released from the case; volume fractions of the gas and particles. Closure of the equations is obtained using a two-equation turbulence model. Preliminary calculations are described in which the proportions of particle additives in the cartridge case was altered. The model gives a good prediction of the ballistic performance and the gas to wall heat transfer. However, the expected magnitude of reduction in heat transfer when particles are present is not predicted. The predictions of gas flow invalidate some of the assumptions made regarding case and propellant behavior during combustion and further work is required to investigate these effects and other possible interactions, both chemical and physical, between gas and particles. Author

N86-29076# Royal Armament Research and Development Establishment, Fort Halstead (England).
NOVEL IGNITION SYSTEMS FOR HEAVY CALIBRE GUNS
C. N. Bowden, G. G. Cook, and P. S. Henning *In* AGARD Interior Ballistics of Guns Jan. 1986 11 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

In recent years there was a trend towards steadily rising gun pressures, especially in direct fire weapons and this has caused many functional problems to arise with conventional vent tube ignition systems. To overcome these problems and to allow the process of gun development to continue, the United Kingdom is performing a program of research into a number of ignition systems for heavy caliber guns. These include: spark ignition, laser ignition, and electrical impulse ignition. A number of different spark plug configurations were evaluated. Extensive trials were performed on the ignition characteristics of black powders and black powder substitutes using an experimental 4 J neodymium laser. Work was also performed on the development of high pressure sapphire windows. A study into methods of charge ignition by electrical impulse techniques was also performed. Author

N86-29077# Dynamit Nobel A.G., Fuerth (West Germany). Dept. of Research and Development-Ammunition.
IGNITION OF HIGH-PERFORMANCE GUN AMMUNITION c28
Horst Penner *In* AGARD Interior Ballistics of Guns Jan. 1986 7 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

Modern high performance cartridges are designed for high loading densities of propelling charges. Sometimes they exceed the normal filling density of the propellant grains. The conditions for fast and complete ignition are discussed and a group of primers for 105 mm-rounds which will ignite the propelling charge in an optimum manner is presented. Author

N86-29078# Institut Franco-Allemand de Recherches, St. Louis (France).
HIGH-PRESSURE COMBUSTION: COMPARISON OF THEORETICAL AND ACTUAL RESULTS [COMBUSTION SOUS HAUTES PRESSIONS CONFRONTATION THEORIE EXPERIENCE]
D. Grune and M. Samirant *In* AGARD Interior Ballistics of Guns Jan. 1986 7 p In FRENCH (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

Following the observation of important variances (30 to 50%) between the theoretical and actual values obtained during a study of the combustion pressure of powders of approximately 1,500 MPa, the differences for several tests were compared. The composition of the combustion gases were analyzed. In addition, the deformation of a manometer explosive device was studied during the ignition stage. Data was obtained concerning the deformation resulting from the high pressure. B.G.

N86-29079# Joint Publications Research Service, Arlington, Va.
EUROPE REPORT: SCIENCE AND TECHNOLOGY
18 Jun. 1986 109 p Transl. into ENGLISH from various European articles
(JPRS-EST-86-008) Avail: NTIS HC A06/MF A01

Topics addressed include: biotechnology, civil aviation, computers, defense industries, microelectronics, scientific and industrial policy, factory automation, lasers, sensors, optics, and technology transfer. For individual titles, see N86-29080 through N86-29082.

N86-29080# Joint Publications Research Service, Arlington, Va.
AERITALIA: AVIONICS, OPTOELECTRONICS RESEARCH, ATR 42 c06
Alberto Mondini *In its* Europe Report: Science and Technology (JPRS-EST-86-008) 18 Jun. 1986 p 2-5 Transl. into ENGLISH from Science Duemila (Rome, Italy), no. 4, Apr. 1986 p 30-33 (For primary document see N86-29079 20-31)
Avail: NTIS HC A06/MF A01

The avionic systems on aircraft being designed by Aeritalia are discussed. The installation of the first European optical fiber system on board a G-22 aircraft of the Italian Air Force is planned. This experiment will be the start of a new phase of study for the

installation of a complete optical fiber system on board an advanced aircraft. The Automatic Test Equipment (ATE) is explained. Also discussed is the telematic laser targeting equipment for armored vehicles. Propfan technology is examined. B.G.

N86-29081# Joint Publications Research Service, Arlington, Va.
DIEHL WEAPONS LAB WORKS ON SENSORS, LASERS, FLIGHT CONTROL
Wolfgang Flume *In its* Europe Report: Science and Technology (JPRS-EST-86-008) 18 Jun. 1986 p 25-28 Transl. into ENGLISH from Wehrtechnik (Bonn, West Germany), Apr. 1986 p 103, 104 (For primary document see N86-29079 20-31)
Avail: NTIS HC A06/MF A01

The Diehl Weapons Laboratory activities include: warheads, ballistics, sensor technology, mensuration technology, and simulation. The facilities at the laboratory are described. Research projects are summarized. B.G.

N86-29082# Joint Publications Research Service, Arlington, Va.
PROPERTIES, APPLICATIONS, FUTURE OF EUROPEAN GYRO SENSORS **c35**
Werner Hansli *In its* Europe Report: Science and Technology (JPRS-EST-86-008) 18 Jun. 1986 p 29-32 Transl. into ENGLISH from Wehrtechnik (Bonn, West Germany), Apr. 1986 p 62, 65-66 (For primary document see N86-29079 20-31)
Avail: NTIS HC A06/MF A01

The mechanical gyroscope was used since the time of World War I as a sensor for measuring angular velocities for the purpose of navigation and flight control. The characteristic configuration was the fixed-in-space mount (cardan mount). With the appearance of the microprocessor, it is now possible to mount gyro devices fixed to the airframe (strapdown mount). Various gyro types are discussed as well as their specific suitability and areas of applications. Future prospects are also examined. B.G.

32 COMMUNICATIONS

Includes land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Spacecraft Communications, Command and Tracking.*

N86-29083 Royal Signals and Radar Establishment, Malvern (England).
RSRE RESEARCH REVIEW, 1985 Annual Report
A. J. Grant, ed., E. Jakeman, ed., and J. Clarke, ed. 1985 196 p
(AD-A163899; BR98221; ESA-86-97111) Avail: NTIS HC A09/MF A01

Research concerning radar and microwaves; communications and computing; signal and data processing; infrared imagery and lasers; and solid state physics and displays is discussed. For individual titles, see N86-29084 through N86-29113.

N86-29084 Royal Signals and Radar Establishment, Malvern (England).
THE UK RADAR SCENE TODAY
J. Clarke *In its* RSRE Research Review, 1985 1985 p 1-15 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Primary radar systems in the United Kingdom that recently entered service or are at an advanced stage of development are presented. Naval, airborne, and land-based types and civil and military radars, especially airborne equipment, are discussed. ESA

N86-29085 Royal Signals and Radar Establishment, Malvern (England).
AN EXPERIMENTAL PHASE-CODED RADAR FOR THE MILLIMETER BAND
P. A. Jefford, D. E. Lloyd, and J. C. Parker *In its* RSRE Research Review, 1985 1985 p 16-22 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

A phase coded radar was used to demonstrate techniques relevant to the need for low-cost integrated microwave and millimeter wave systems. The technique is particularly useful in solid-state systems for tracking and guidance applications where sufficient transmitter power is not available from pulsed devices. The design exploits the simplicity and low cost of a single device IMPATT oscillator as a transmitter together with repeatable implementation of the RF hardware, while providing adequate performance for many applications. Angle tracking is provided by a monopulse receive antenna, and range discrimination is achieved using maximal length or pseudorandom code sequences which are modulated onto the transmitted CW carrier by a phase reversal switch. ESA

N86-29086 Royal Signals and Radar Establishment, Malvern (England).
BISTATIC RADAR FOR LONG RANGE APPLICATIONS
Chris Pell *In its* RSRE Research Review, 1985 1985 p 23-27 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

The main characteristics and properties of bistatic radar as applied to long range air target detection are summarized. System functions are highlighted and processing tasks required are indicated. An example of a bistatic system is used to illustrate the likely detection performance and surveillance coverage that could be achieved. ESA

N86-29087 Royal Signals and Radar Establishment, Malvern (England).
NEW ANTENNAS FOR SECONDARY SURVEILLANCE RADAR
J. M. Shaw *In its* RSRE Research Review, 1985 1985 p 28-30 Sponsored by UK Civil Aviation Aurthority (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Large vertical aperture antenna (LVA) radars in monopulse and sliding window modes were compared with hogtrough antennas. Track quality and vertical lobing were assessed. Results confirm the greatly superior performance of the LVA design. ESA

N86-29088 Royal Signals and Radar Establishment, Malvern (England).
COHERENT AND NONCOHERENT PROPERTIES OF K DISTRIBUTED SEA CLUTTER
Chris J. Baker and Keith D. Ward *In its* RSRE Research Review, 1985 1985 p 31-33 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

A model based on the compound K-distribution is described and related to coherent as well as noncoherent processing of sea clutter. The model's main advantage is in its treatment of the correlation properties, through the separation into two multiplicative components. It is demonstrated that the application of this model provides much more realistic prediction and optimization of signal processing. ESA

N86-29089 Royal Signals and Radar Establishment, Malvern (England).
SYNTHETIC APERTURE RADAR
T. M. Mason *In its* RSRE Research Review, 1985 1985 p 34-38 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

The development of digital SAR is reviewed. Coherence and motion compensation requirements are discussed. Self focusing, terrain classification, and resolution enhancement are considered. ESA

N86-29090 Royal Signals and Radar Establishment, Malvern (England).
TRANSIENT FIELD GENERATION AND MEASUREMENT
David M. Parkes and Paul D. Smith *In its* RSRE Research Review, 1985 1985 p 39-44 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

The mathematical modeling and numerical computation of the elecromagnetic field radiated by a biconic antenna excited by a transient waveform such as a pulse are outlined. Very good agreement between the model and experiment is achieved for the time history of the radiated pulse. Amplitudes of calculated field strengths are within engineering tolerances. The type of field and its amplitude which result when any variant of biconic antenna is excited by a given input pulse can be predicted, since the time marching method of solving integral equations is shown to be successfully implemented on a computer. Because the system is not limited to single shot events, measurement of induced currents inside target equipments when illuminated by the radiation field is simplified, since sampling technology can be employed. Current waveforms which occur in antennas can also be predicted. ESA

N86-29091 Royal Signals and Radar Establishment, Malvern (England).
SLOW SCAN TELEVISION VIA TACTICAL SATCOMS
Paul Wells *In its* RSRE Research Review, 1985 1985 p 45-47 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

A system which enables near real time moving picture information in redundant scenes to be transmitted over a low data rate tactical satellite communication link is described. The prototype equipment was designed to operate from automobile based satcom terminals using 16 kbit/sec tactical voice links. With the advent of more powerful satellites (SKYNET 4) the equipment should be usable with manpack type satcom terminals. The video codec operates at a constant 16 kbit/sec data rate and is therefore compatible with any 16 kbit/sec digital communications link. The system has two modes of operation: conventional slow scan television to build up the television frame, and conditional replenishment to send the moving picture information. The majority of information in a moving picture scene is stationary and is therefore redundant information. ESA

N86-29092 Royal Signals and Radar Establishment, Malvern (England).
DEMAND ASSIGNED MULTIPLE ACCESS CONTROL FOR TACTICAL SATELLITE COMMUNICATIONS TERMINALS
P. Wayne Braddock, Alan C. Smith, and Steve J. Perkins *In its* RSRE Research Review, 1985 1985 p 48-50 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Demand assigned multiple access implementations in which a central control station monitors traffic and allocates resources, and a distributed scheme whereby all terminals are of equal importance are compared. The distributed approach gives no overall authority to one station and has no connection to any fixed ground stations where land lines can be accessed. The central control system has the advantage that the central station has overall authority and can use land lines. However, by routing links through the center more satellite accesses are used than in the distributed case by a factor of two. The central control system is also heavily reliant on the control station remaining operational. ESA

N86-29093 Royal Signals and Radar Establishment, Malvern (England).
MALVERN'S PROGRAM ANALYSERS
B. D. Bramson *In its* RSRE Research Review, 1985 1985 p 51-52 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

The Malvern Program Analysis Suite for the automatic, static analysis of safety critical software is described. Prior to analysis, a given text is translated into a standard Intermediate Language (IL), thus obviating the need for a new set of analyzers for each programming language. The IL is a strongly typed language with deliberately primitive control constructs so that high and low-level languages may be modeled. Many types are in-built, but new types, functions and procedures may also be declared without elaboration. For each procedure, including the outermost program, six types of analysis are performed: control flow; data use; information flow; partial program; semantics; and threat (matching with specifications). ESA

N86-29094 Royal Signals and Radar Establishment, Malvern (England).
FLEX: RSRE'S CAPABILITY COMPUTER
J. M. Foster *In its* RSRE Research Review, 1985 1985 p 53-55 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

The Flex capability based computer architecture is described. It supports a multilanguage environment, and compilers for ALGOL 168 and PASCAL exist; an Ada compiler is being completed. The idea of capabilities is used on backing store as well as main store, so that all kinds of structured object which can be held in main store can also be held on any of the packing stores with the same degree of protection. Capabilities are used across a network of Flex computers, so that capabilities for data in one machine may be passed to and held in another. Flex uses true procedure values in the sense of Landin (1964). ESA

N86-29095 Royal Signals and Radar Establishment, Malvern (England).
AN OVERVIEW OF OPTICAL SIGNAL PROCESSING TECHNIQUES
Meirion F. Lewis *In its* RSRE Research Review, 1985 1985 p 57-65 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Optics applications in signal processing, principally fiber optics for low loss data transmission, and acousto-optics in spectrum analysis are reviewed. In each case the performance of the optical device greatly surpasses that of alternative technologies. The principal limitations of most other applications of optics concern their accuracy and dynamic range, and the problem of interfacing with electronics. The most obvious and important problem concerns the nonavailability of a cheap, reliable, reproducible spatial light modulator. This precludes the exploitation of many two-dimensional optical processors. The attraction of all-optical computing is boosted by the problems encountered in VLSI, although it is likely to be many years before such devices seriously compete with digital electronics. ESA

N86-29096 Royal Signals and Radar Establishment, Malvern (England).
ANDIE
M. Barraclough *In its* RSRE Research Review, 1985 1985 p 66-68 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

A data handling rig to assist the development of an Airborne Early Warning (AEW) radar is described. The rig assesses AEW performance as a self-contained entity, studies the interoperability of the AEW with other components of the air defense system, and assesses system enhancements. ESA

N86-29097 Royal Signals and Radar Establishment, Malvern (England).
APPLICATION OF SEMI-MARKOV MODELS TO AUTOMATIC SPEECH RECOGNITION
M. J. Russell and R. K. Moore *In its* RSRE Research Review, 1985 1985 p 69-72 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Automatic speech recognition using a statistical pattern recognition technique called hidden Markov modeling is introduced. With this technique each word in a vocabulary is represented as a probabilistic function of a Markov process, or hidden Markov model. A hidden Markov model consists of an underlying Markov chain, plus a set of multivariate probability density functions, one for each node of the Markov chain, called the states of the model. Intuitively the states describe variations in the pronunciation of different regions of a word while the underlying Markov chain describes the temporal structure of that word. Thus in hidden Markov modeling a speech signal is treated as the output of a sequence of stationary stochastic processes. ESA

N86-29098 Royal Signals and Radar Establishment, Malvern (England).
PRIOR KNOWLEDGE IN SYNTHETIC APERTURE RADAR (SAR) PROCESSING
S. P. Luttrell and C. J. Oliver *In its* RSRE Research Review, 1985 1985 p 73-77 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Application of information theory concepts of the relation between model and data interpretation to SAR processing is discussed. A model with correlated gamma-distributed cross section fluctuations fits the clutter which is observed in SAR data. Such a model can be augmented by the inclusion of collateral map data of the scene which the SAR is surveying. Thus the map may be used to determine the clutter model parameters in advance of receiving the SAR image data. Regions of the SAR image inconsistent with this clutter model (targets) require a different model. A general method of interpreting such target data is provided by superresolution. Thus prior knowledge of the general properties of targets is introduced to extract the maximum amount of target structural detail from the image. The effect of such processing is to enhance the resolution of the target image. ESA

N86-29099 Royal Signals and Radar Establishment, Malvern (England).
THE INFRARED APPLICATIONS OF CHALCOGENIDE GLASSES
Jim Savage *In its* RSRE Research Review, 1985 1985 p 79-94 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

The optical and general properties of bulk chalcogenide glasses are summarized. Loss mechanisms in infrared materials; intrinsic absorption mechanisms; intrinsic scatter mechanisms; and extrinsic loss mechanisms are discussed. Sulfide glasses; selenide glasses; selenide-telluride glasses; and telluride glasses are covered. ESA

N86-29100 Royal Signals and Radar Establishment, Malvern (England).
CADMIUM MERCURY TELLURIDE INFRARED DETECTORS
C. T. Elliott *In its* RSRE Research Review, 1985 1985 p 95-103 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Signal Processing In The Element (SPITE) detectors used in high performance thermal imaging systems are discussed. Developments to improve spatial and temperature resolution are outlined. Focal plane arrays of electronically scanned two-dimensional arrays of CMT detectors are treated. Use of photovoltaic CMT detectors hybridized with silicon addressing circuits is reported. Research to raise the operating temperature of infrared detectors is summarized. ESA

N86-29101 Royal Signals and Radar Establishment, Malvern (England).
NON-GAUSSIAN LIGHT SCATTERING EXPERIMENTS
Eric Jakeman *In its* RSRE Research Review, 1985 1985 p 104-112 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Data acquired in light scattering experiments to investigate non-Gaussian fluctuations are given. Dynamic scattering in liquid crystals, laboratory generated thermal plumes, mixing layers, rippled liquid surfaces, and specially prepared solid diffusers were studied. At a qualitative level, the visual appearance of a scattered intensity pattern can be used to distinguish between smoothly varying and fractal scatterers. Solutions of Maxwell's equations for the appropriate model can then in principle be used to make quantitative comparisons with experimental data and obtain estimates of significant parameters characterizing the scatterer. In practice, anomalies remain, for example the observed strong geometrical optics features generated when waves are scattered by turbulent media which are usually considered to be describable in terms of the (fractal) Kolmogorov spectrum. ESA

N86-29102 Royal Signals and Radar Establishment, Malvern (England).
TUNABLE LASERS
M. J. P. Payne, R. C. Hollins, D. L. Jordan, H. W. Evans, and N. A. Lowde *In its* RSRE Research Review, 1985 1985 p 113-115 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Research on tunable carbon dioxide lasers for the 10 micron spectral region, vibronic solid state lasers for the visible and near infrared, dye lasers, and tunable excimer lasers is summarized. ESA

N86-29103 Royal Signals and Radar Establishment, Malvern (England).
A PYROELECTRIC LINEAR ARRAY INFRARED IMAGER
Douglas E. Burgess, P. A. Manning, and Rex Watton *In its* RSRE Research Review, 1985 1985 p 116-117 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

A linear pyroelectric infrared detector array featuring room temperature operation and low cost was demonstrated in a prototype imager. The use of uncommitted logic arrays and hybrid techniques to miniaturize the sensor head electronics is mentioned. ESA

N86-29104 Royal Signals and Radar Establishment, Malvern (England).
HIGH POWER FIBER OPTIC LASER ANEMOMETRY
Robert G. W. Brown, D. A. Jackson, J. D. C. Jones, and R. K. Y. Chan *In its* RSRE Research Review, 1985 1985 p 118-120 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Power transmission measurements in monomode optical fibers are reviewed. Hazards influencing the design and construction of high power fiber laser anemometers are listed. It is predicted that monomode optical fibers capable of delivering hundreds of milliwatts of CW laser light over tens of meters to laser anemometer measuring regions will be developed in the near future. These will form the basis of multiplexable, miniaturized and relatively inexpensive laser anemometer optics. ESA

N86-29105 Royal Signals and Radar Establishment, Malvern (England).
HIGH SPATIAL RESOLUTION THERMAL IMAGERS
Ann P. Campbell *In its* RSRE Research Review, 1985 1985 p 121-123 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

The effect of anamorphic detector optics on Signal Processing In The Element (SPITE) detectors is discussed. Anamorphic optics enable a substantial improvement in horizontal detector modulation transfer function to be realized without requiring any detector geometry changes, and with a minimal loss in thermal sensitivity. Anamorphic detector optics were designed for thermal imaging common modules, as a form, fit and function retrofit to existing imagers. The only adjustment required is an increase in bias current, and this can be accomplished with the present bias supply circuits. The consequent increase in power dissipation is easily accomodated with the current detector and dewar combination. Comparison of images taken using an imager with standard optics and an imager with anamorphic optics demonstrates substantially improved spatial resolution. ESA

N86-29106 Royal Signals and Radar Establishment, Malvern (England).
IDENTIFICATION OF IMPURITIES AND DEFECTS IN SEMICONDUCTORS BY OPTICAL SPECTROSCOPY
M. S. Skolnick *In its* RSRE Research Review, 1985 1985 p 125-135 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Information that can be obtained on defect centers in semiconductors by optical spectroscopy is reviewed. Donor and acceptor identification, and symmetry determination of transition metal and axial defect-complex centers are considered. The information that can be obtained from isotope doping effects is discussed. ESA

N86-29107 Royal Signals and Radar Establishment, Malvern (England).
LOW DIMENSIONAL STRUCTURES
David A. Anderson and Colin R. Whitehouse *In its* RSRE Research Review, 1985 1985 p 136-141 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

The growth of quantum wells and techniques to probe the electronic properties of material only a few atomic layers thick are discussed. Molecular beam epitaxy is introduced. The electronic and optical properties of the structures produced are summarized, and utilization prospects are considered. ESA

N86-29108 Royal Signals and Radar Establishment, Malvern (England).
PYROELECTRIC ACTIVITY IN NON-CENTROSYMMETRIC LANGMUIR-BLODGETT FILMS
Mervyn Daniel and Gilbert W. Smith *In its* RSRE Research Review, 1985 1985 p 142-145 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

A mechanism to deposit noncentrosymmetric Langmuir-Blodgett (LB) films is described. The device can produce noncentrosymmetric organic films with useful properties such as pyroelectric and optically nonlinear behavior. Pyroelectric activity was observed and quantified in an acid/amine alternating layer LB film. As materials with custom-designed properties become available, these synthetic low-dimensional solids can produce a variety of effects with device potential. ESA

N86-29109 Royal Signals and Radar Establishment, Malvern (England).
FUNDAMENTAL STUDIES OF ION-SURFACE INTERACTIONS IN DRY ETCHING
Timothy I. Cox and Vasant G. I. Deshmukh *In its* RSRE Research Review, 1985 1985 p 146-149 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Reactive ion beam etching of silicon using fluorocarbon gases with different C/F ratios in the parent molecule is described. Surface composition was studied via induced light emission. The relative amounts of the ionic species are a sensitive function of the gas pressure and source conditions, and are used to study ion surface interactions pertinent to dry etching for a wide range of beam compositions and ion energies. At low bombardment energies, neither a bombardment-induced silicon optical emission signal nor a signal at m/e = 28 (Si^+) in the ion spectrum is observed. A threshold energy for the appearance of these signals is found. Mass spectrometric results confirm that the incident fluorocarbon beam is highly fragmented on impact with a silicon surface. Carbon so generated has a high probability of sticking to silicon and can act as a surface passivant, but may be removed by physical sputtering or by chemical combination with fluorine to form CF4 (gas). As ion energy increases the physical and chemical removal rates of carbon per incident fluorine atom increase and the fraction of the surface covered by carbon decreases. ESA

N86-29110 Royal Signals and Radar Establishment, Malvern (England).
A LIQUID CRYSTAL RADAR DISPLAY
John L. Glasper and Charles J. T. Smith *In its* RSRE Research Review, 1985 1985 p 150-154 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

A liquid crystal display for the MISER experimental radar for the evaluation of millimetric surveillance techniques was developed. The display consists of 2 large area matrix addressed displays and 12 direct drive numeric displays for axes designation and target parameters. The circular display plots data using polar coordinates to produce a PPI type presentation with the square display plotting data using rectangular coordinates to show a magnified area of the PPI display. The axes designators define the position and extent of the enlarged region and the target parameter displays track a selected target. The display unit is a combination of LCD modes; the large area displays are dyed phase change driven by waveform identity addressing, whereas the numeric displays are direct drive twisted nematic. ESA

N86-29111 Royal Signals and Radar Establishment, Malvern (England).
ULTRA HIGH SPEED MICRO-OPTICAL MODULATIONS IN GaAs: THE TEAM AND THE LEAM
David R. Wight, Phil C. Allen, John W. A. Trussler, Don P. Cooper, Dan J. Esdale, and Peter E. Oliver *In its* RSRE Research Review, 1985 1985 p 155-158 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

The design and performance of two types of optical modulators utilizing the bulk electroabsorption effect are described. Both types are of micron active dimensions and produce modulation depths of up to 50% without being optimized. The simpler transverse structure was tested to high frequency operation and is shown to have a flat response from dc to at least 14 GHz. The small size and high frequency performance of the devices offer a significant capability in fast signal transmission and processing electronics. ESA

N86-29112 Royal Signals and Radar Establishment, Malvern (England).
PHOTOLUMINESCENCE STUDIES OF SILICON GROWTH BY MBE
D. J. Robbins, D. B. Gasson, R. W. Hardeman, and A. D. Pitt *In its* RSRE Research Review, 1985 1985 p 159-163 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

Photoluminescence was used to study defects introduced during silicon wafer cleaning and subsequent growth. Dislocations in epilayers nucleated by residual substrate surface oxide; residual crystallographic damage introduced by sputter-cleaning of the substrate; and carbon incorporated during growth were examined. ESA

N86-29113 Royal Signals and Radar Establishment, Malvern (England).
HISTORY OF THE RSRE
Ernest H. Putley *In its* RSRE Research Review, 1985 1985 p 165-174 (For primary document see N86-29083 20-32)
Avail: NTIS HC A09/MF A01

The history of the United Kingdom Royal Signal and Radar Establishment is summarized. Its development of radar was an indirect result of investigations of so-called death rays in the 1930s. Other contributions include work on solid state detectors, infrared imagery, and the discovery of molecular gas lasers. Author (ESA)

N86-29114*# General Electric Co., Philadelphia, Pa. Space Systems Div.
THE 60 GHz ANTENNA SYSTEM ANALYSES FOR INTERSATELLITE LINKS, PHASE B Final and Summary Report
Sep. 1984 146 p
(Contract NAS5-27791)
(NASA-CR-175267; NAS 1.26:175267; GE-84SD54262) Avail: NTIS HC A07/MF A01 CSCL 17B

The purpose of this study is first to investigate, classify, and compare applicable antenna systems capable of establishing and maintaining intersatellite links at 60 GHz and secondly to select the most applicable system for a detailed conceptual design. The results are to be applicable to the development of intersatellite links at 60 GHz for future programs. Design goals are listed. Author

N86-29115*# Martin Marietta Corp., Denver, Colo.
NEAR-FIELD TESTING OF THE 15-METER MODEL OF THE HOOP COLUMN ANTENNA Final Report
John Hoover, Neill Kefauver, Tom Cencich, Jim Osborn, and Joe Osmanski Mar. 1986 123 p
(Contract NAS1-18016)

(NASA-CR-178059; NAS 1.26:178059; MCR-85-640) Avail: NTIS HC A06/MF A01 CSCL 20N

The technical results from near-field testing of the 15-meter model of the hoop column antenna at the Martin Marietta Denver Aerospace facility are documented. The antenna consists of a deployable central column and a 15 meter hoop, stiffened by cables into a structure with a high tolerance repeatable surface and offset feed location. The surface has been configured to have four offset parabolic apertures, each about 6 meters in diameter, and is made of gold plated molybdenum wire mesh. Pattern measurements were made with feed systems radiating at frequencies of 7.73, 11.60, 2.27, 2.225, and 4.26 (all in GHz). This report (Volume 1) covers the testing from an overall viewpoint and contains information of generalized interest for testing large antennas. This volume discusses the deployment of the antenna in the Martin Facility and the measurements to determine mechanical stability and trueness of the reflector surface, gives the test program outline, and gives a synopsis of antenna electromagnetic performance. Three techniques for measuring surface mechanical tolerances were used (theodolites, metric cameras, and near-field phase), but only the near-field phase approach is included. The report also includes an error analysis. A detailed listing of the antenna patterns are provided for the 2.225 Ghz feed in Volume 3 of this report, and for all other feeds in Volume 2. Author

N86-29116*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

WORKLOAD CHARACTERIZATION FOR THE SPACE STATION DATA COMMUNICATIONS SYSTEM

Kenneth C. Sevcik Jan. 1986 15 p

(NASA-TM-89396; RIACS-TR-86.4; NAS 1.15:89396) Avail: NTIS HC A02/MF A01 CSCL 17B

NASA plans to launch a permanent manned space station in the early 1990's. The station will be used to support a wide variety of activities involving Earth and space observation, satellite maintenance, scientific experimentation, and commercial manufacturing. The control and monitoring of many of these activities will require extensive computer and communications system support. In order to identify an appropriate computer and communication system for supporting the space station, an attempt to characterize the space station's data communications subsystem workload is currently underway. Some of the special aspects of the workload characterization problem are discussed in connection with the space station, and some possible approaches are presented. Author

N86-29117*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.

A MICROPROCESSOR BASED ANTI-ALIASING FILTER FOR A PCM SYSTEM Final Report, 31 Oct. 1980 - 31 Oct. 1984

Daniel Creighton Morrow and Doral R. Sandlin Oct. 1984 160 p

(Contract NCC4-1)

(NASA-CR-177000; NAS 1.26:177000) Avail: NTIS HC A08/MF A01 CSCL 17B

Described is the design and evaluation of a microprocessor based digital filter. The filter was made to investigate the feasibility of a digital replacement for the analog pre-sampling filters used in telemetry systems at the NASA Ames-Dryden Flight Research Facility (DFRF). The digital filter will utilize an Intel 2920 Analog Signal Processor (ASP) chip. Testing includes measurements of: (1) the filter frequency response and, (2) the filter signal resolution. The evaluation of the digital filter was made on the basis of circuit size, projected environmental stability and filter resolution. The 2920 based digital filter was found to meet or exceed the pre-sampling filter specifications for limited signal resolution applications. Author

N86-29118*# California Univ., Los Angeles. Dept. of Electrical Engineering.

A SURVEY OF THE STATE-OF-THE-ART AND FOCUSED RESEARCH IN RANGE SYSTEMS, TASK 1 Final Report

Jim K. Omura Jul. 1986 43 p

(Grant NAG2-304)

(NASA-CR-176900; NAS 1.26:176900) Avail: NTIS HC A03/MF A01 CSCL 17B

This final report presents the latest research activity in voice compression. We have designed a non-real time simulation system that is implemented around the IBM-PC where the IBM-PC is used as a speech work station for data acquisition and analysis of voice samples. A real-time implementation is also proposed. This real-time Voice Compression Board (VCB) is built around the Texas Instruments TMS-3220. The voice compression algorithm investigated here was described in an earlier report titled, Low Cost Voice Compression for Mobile Digital Radios, by the author. We will assume the reader is familiar with the voice compression algorithm discussed in this report. The VCB compresses speech waveforms at data rates ranging from 4.8 K bps to 16 K bps. This board interfaces to the IBM-PC 8-bit bus, and plugs into a single expansion slot on the mother board. Author

N86-29119# Army Aviation Systems Command, St. Louis, Mo.

VHF-FM COMMUNICATIONS ANTENNAS FOR PROJECT SINCGARS (UH-1 TAIL WHIP ANTENNA EVALUATION)

Joseph Caralyus, Joseph Miller, and Frank Cansler Feb. 1986 129 p

(AD-A165897; AVSCOM-TR-85-E-2) Avail: NTIS HC A07/MF A01 CSCL 17/2

A full-scale study was conducted by the Naval Air Development Center, Warminster, Penn. (NADC), for the C3 Division of the U.S. Army Avionics Research and Development Activity (AVRADA), Fort Monmouth, N.J., to test and evaluate production prototype antenna systems that essentially met the requirement for SINCGARS operation when installed on an Army UH-1 helicopter. The results of these tests determined a suitable tail whip antenna to be used on the UH-1 to satisfy the SINCGARS requirement between 30 and 88 MHz. This technical report describes the results of tests conducted on antennas manufactured by three major Airborne Antenna manufacturers, each of whom attempted to provide an antenna system that would directly replace the standard Army CU-942B antenna, and satisfy the more stringent requirements of project SINCGARS. The information in this report provides, in part, the technical data for the production data package of an adequate VHF-FM Communications antenna for the UH-1 aircraft. GRA

N86-29120# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

EXPLOITING SEQUENTIAL PHONETIC CONSTRAINTS IN RECOGNIZING SPOKEN WORDS

Daniel P. Huttenlocher Oct. 1985 28 p

(Contract N00014-80-C-0505)

(AD-A165913; AI-M-867) Avail: NTIS HC A03/MF A01 CSCL 05/8

Machine recognition of spoken language requires developing more robust recognition algorithms. A recent study by Shipman and Zue suggest using partial descriptions of speech sounds to eliminate all but a handful of word candidates from a large lexicon. The current paper extends their work by investigating the power of partial phonetic descriptions for developing recognition algorithms. First, we demonstrate that sequences of manner of articulation classes are more reliable and provide more constraint than certain other classes. Alone these results are of limited utility, due to the high degree of variability in natural speech. This variability is not uniform however, as most modifications and deletions occur in unstressed syllables. Comparing the relative constraint provided by sounds in stressed versus unstressed syllables, we discover that the stressed syllables provide substantially more constraint. This indicates that recognition algorithms can be made more robust by exploiting the manner of articulation information in stressed syllables. GRA

N86-29121# Connecticut Univ., Storrs. Dept. of Electrical Engrg. and Computer Science.

A RANDOM ACCESS ALGORITHM FOR FREQUENCY HOPPED SPREAD SPECTRUM PACKET RADIO NETWORKS

Michael Georgiopoulos and P. Papantoni-Kazakos Mar. 1986

24 p
(Contract N00014-85-K-0547)
(AD-A165935; EECS-TR-86-4) Avail: NTIS HC A02/MF A01 CSCL 17/2

The authors consider packet radio multi-user spread-spectrum environments, where frequency hopping spread spectrum techniques are deployed for protection against intelligent adversaries. When the users in such environments are mobile and bursty, random access frequency hopping transmission algorithms should be adopted, for efficiency in throughput and delay control. This paper proposes and analyzes such an algorithm, named Collision Resolution Algorithm for Frequency Hopping (CRAFH). The CRAFH is a limited sensing random access algorithm utilizing receiver oriented frequency hopping patterns. In its design, the experience from random access algorithms for non spread spectrum multi-user channels is utilized. Utilizing the regenerative character of the induced by the algorithm transmission process, the authors compute throughputs and expected per packet delays. In the presence of interferences between transmissions to different receivers, we compute throughputs, subject to an upper bound on the probability of erroneous data decoding. The CRAFH induces uniformly good delays within its stability region, and is particularly appropriate for environments where the users are highly mobile. GRA

N86-29122# Naval Surface Weapons Center, Silver Spring, Md.
DISPERSION CHARACTERISTICS OF A HELIX LOADED WAVEGUIDE
H. Crosby, J. Choe, and A. Krall 1 Sep. 1985 43 p
(AD-A166444; NSWC/TR-85-402) Avail: NTIS HC A03/MF A01 CSCL 09/1

The dispersion characteristics of a helix loaded waveguide have been experimentally investigated. Helix loaded waveguides are of interest as a slow wave structure that can be employed to increase the bandwidth of gyroton amplifiers. The structure consists of helical wires contained concentrially in a cylindrical conductor. The helical wires are close enough together to form a helical sheath justifying the assumption of azimuthal symmetry. The relevant physical parameters are the pitch angle (phi) and the ratio of the helix radius (Rh) to the conductor radius (Rc). The dispersion relations for the general azimuthal mode number are obtained for both the fast hybrid and the helix modes. GRA

N86-29123# Lawrence Livermore National Lab., Calif.
SCALE MODEL EVALUATION OF A REFLECTING ANTENNA DESIGN FOR AN INDOOR EMP SIMULATOR
H. G. Hudson and S. T. Pennock Dec. 1985 30 p
(Contract W-7405-eng-48)
(DE86-008146; UCID-20685) Avail: NTIS HC A03/MF A01

The purpose of this effort was to construct a scale model of a cusp antenna and evaluate its performance. Measurements were taken to describe the distortion the presence of the cusp introduced into a free space incident field. Measurements of the hangar were also taken to serve as a reference point to gauge how much the cusp was able to reflect energy. As will be described in detail later, the measured performance of the scale model cusp antenna does not agree with the predicted computer solutions from EMA. DOE

N86-29124# Research Inst. of National Defence, Linkoeping (Sweden).
THE CARABAS METHOD TO OBTAIN HIGH RESOLUTION PENETRATING RADAR RECORDINGS OF THE GROUND
Hans Hellsten, Jan Kjellgren, and Svante Oedman Jan. 1986 22 p In SWEDISH; ENGLISH summary
(FOA-C-30414-E1; ISSN-0347-3708; ESA-86-97041) Avail: NTIS HC A02/MF A01; Research Inst. of National Defence, Stockholm, Sweden KR 50

Information content in recordings of the ground surface readings obtained by SAR is analyzed. The speckle ambiguity characteristic of conventional SAR, a consequence of the small relative bandwidth, restrains interpretability. In CARABAS the maximum broadband signal is used: typically 10 to 100 MHz. The high angular resolution of the SAR technique combined with large absolute bandwidth provides unchanged high resolution, compared to microwave SAR, but the information content of recorded data is different. In the wavelength interval 3 to 30 m, vegetation is transparent and radiation penetrates the ground to a depth of 10 m. ESA

N86-29125# Centre National d'Etudes Spatiales, Toulouse (France).
METEOSAT OPERATIONAL INTRODUCTION OF NEW CARRIERS IN A2 METEOROLOGICAL DATA DISSEMINATION (MDD)
M. Grondin 29 Mar. 1985 20 p
(CNES-CT/DRT/TIT/TR-67-T; ESA-86-97182) Avail: NTIS HC A02/MF A01

The possibility of replacing several Meteosat meteorological data dissemination (MDD) carriers by a higher bit rate carrier, and replacing one MDD carrier by a lower bit rate carrier was studied. The power sharing between the carriers and the intermodulation products (C/I ratios) are evaluated. It is concluded that replacing 5 MDD carriers by the high bit rate carrier (at 2.4 kbs) does not degrade the reception of the remaining MDD carriers, and that the reception of the new carrier with a bit error rate of 0.000001 is possible, assuming that a suitable frequency plan is chosen. For the reception of the low bit rate carrier the result is similar, but the C/I ratio obtained must be used with care because of the limits of the simulation. ESA

N86-29126# Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France). Dept. RPE/ETP.
RADIO PROPAGATION AT 900 MHz IN URBAN AREAS: MODELS WITH A FIXED FREQUENCY AND EXPERIMENTAL RESULTS [PROPAGATION RADIOELECTRIQUE A 900 MHLCZ EN MILIEU URBAIN: MODELISATION A FREQUENCE FIXE ET RESULTATS EXPERIMENTAUX]
P. Olivier and J. Tiffon Sep. 1984 65 p In FRENCH
(CRPE-NT-136; ESA-86-97189) Avail: NTIS HC A04/MF A01

Models which describe multipath propagation are examined in order to design a 900 MHz mobile communication system adapted to urban areas. A justification of the experimental data treatment is derived from this analysis. The measurements were made at a fixed 855 MHz frequency, transmitting from three locations. The fast fluctuations of the received signals are well represented by a Rayleigh process, which means that there are practically no paths of direct transmission. The coherence length is < 1 m. The statistical distribution of the average field is Gaussian and the normal deviation decreases with the distance emitter-receiver. The empiric Okumura-Hata prediction model agrees well with the experimental results, giving an average cell field decreasing with distance with a logarithmic law. ESA

N86-29127# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Systemes et Communications.
MULTISENSOR MULTIPULSE LINEAR PREDICTIVE CODING (LPC) ANALYSIS IN NOISE FOR MEDIUM RATE SPEECH TRANSMISSION Final Report
Robert D. Preuss 30 Dec. 1985 36 p Sponsored by Ecole Nationale des Telecommunications, Centre National d'Etudes des Telecommunications, Lannion, France, and CNRS, Ivry sur Seine, France
(ENST-85D005; ISSN-0751-1345; ESA-86-97211) Avail: NTIS HC A03/MF A01

The theory of multipulse linear predictive coding (LPC) analysis is extended to include the possible presence of acoustic noise, as for a telephone near a busy road. Models are developed assuming two signals are provided: the primary signal is the output of a microphone which samples the combined acoustic fields of the noise and the speech, while the secondary signal is the output of a microphone which samples the acoustic field of the noise alone. Analysis techniques to extract the multipulse LPC parameters from these two signals are developed; these techniques are developed as approximations to maximum likelihood analysis for the given model. ESA

N86-29128# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
IMPLEMENTATION OF A SOFT-DECISION VITERBI CODEC
W. J. W. M. Nouwens Dec. 1984 75 p
(ESA-86-97542) Avail: NTIS HC A04/MF A01

The effects of the threshold spacing and the number of quantization levels (Q) on the bit error probability of a soft-decision decoder are investigated. An upper bound on the bit error probability is computed as a function of the threshold spacing and Es/No for Q=4 and Q=8. Threshold spacing normalized to the noise-power density, and normalized to the signal energy per code symbol are considered. Degradation of bit error probability performance is not significant even if the threshold spacings differ considerably from the optimum values. A parallel realization of the decoder with eight quantization levels is chosen. The theoretical minimum decoding data rate is at least 4 Mbs. The bit error rate performance of the decoder is measured with a polar baseband channel. The code gain of the decoder is 3.4 dB for Q=8 and 3.1 dB for Q=4. ESA

N86-29129# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. d'Informatique.
EXPRESSION OF COOPERATION, COMPETITION, COMMUNICATION IN SPECIFICATIONS BY ABSTRACT ALGEBRAIC TYPES Ph.D. Thesis [EXPRESSION DE C3 (COOPERATION, CONCURRENCE, COMMUNICATION) DANS LES SPECIFICATIONS PAR LES TYPES ABSTRAITS ALGEBRIQUES]
Hayri Sayi Jul. 1984 141 p In FRENCH and ENGLISH
(ENST-84E019; ISSN-0751-1353; ESA-86-97207) Avail: NTIS HC A07/MF A01

Examples to illustrate a specification describing a system composed of cooperating autonomous units, written in the form of algebraic abstract types, are given. The use of the OASIS computer program, designed to aid interactive specification of structural systems, is emphasized. The analysis of cooperative subsystems, and competing subsystems are discussed. The models describing competing systems separately specified, once intercommunication and the changes induced by that communication are established, are analyzed. The usefulness of this type of specification in describing communication or computer systems is shown. ESA

N86-29130# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Systemes et Communications.
PARAMETER TIME-FREQUENCY REPRESENTATIONS [REPRESENTATIONS TEMPS-FREQUENCE PARAMETRIQUES]
Yves Grenier Sep. 1985 69 p In FRENCH Presented at Summer School Session on Physique Theorique de Houches, NATO ASI on Signal Processing, France, 12 Aug. - 6 Sep. 1985
(ENST-85C006; ISSN-0751-1337; ESA-86-97209) Avail: NTIS HC A04/MF A01

The definition and representation of time varying spectra are discussed. The definitions of Priestley (1965), Tjostheim (1976) and Grenier (1984) are examined. It is shown that the adjusted average autoregressive models may be globally unstable in spite of the stability of their limit models. The analysis finds that the Tjostheim definition and the observable state definition are equivalent in the sense that the first respects the signal variance and the second the instantaneous local conditions. ESA

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics.*

N86-29131# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.
IMPROVED MODE CONVERTERS FOR GENERATING THE HE11 (NEAR-GAUSSIAN) MODE FROM GYROTRON TEOn MODES AT 70 GHz AND 140 GHz
M. Thumm, G. A. Mueller, H. Sturm, R. Wilhelm, and M. Verain Nov. 1985 18 p Presented at EC-5 International Workshop on Electron Cyclotron Emission and Electron Cyclotron Heating and Gyrotron User/Developer Meeting, San Diego, Calif., 9-12 Nov. 1985
(IPF-85-6; ESA-86-96924) Avail: NTIS HC A02/MF A01

Mode converters for generating the He11 (near Gaussian) mode from gyrotron TEOn modes at 70 and 140 GHz and optimization of wall perturbations in rippled mode converters for overmoded circular waveguides are discussed. For individual titles, see N86-29132 through N86-29133.

N86-29132# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.
MODE CONVERTERS FOR GENERATING THE HE11 (NEAR-GAUSSIAN) MODE FROM GYROTRON TEOn MODES AT 140 GHz
Manfred Thumm and Helga Sturm *In its* Improved Mode Converters for Generating the HE11 (Near-Gaussian) Mode from Gyrotron TEOn Modes at 70 GHz and 140 GHz Nov. 1985 p 2-9 (For primary document see N86-29131 20-33)
Avail: NTIS HC A02/MF A01

The structure of wall perturbations (superposition of 2 or 3 different periods) in rippled wall mode converters and the curvature distribution in bent smooth-walled TEO1-to-TM11 mode transducers were optimized by numerically solving the corresponding coupled-mode differential equations. Computer-aided optimization of circumferentially corrugated mode converters was achieved with a scattering matrix code employing the modal field expansion technique. In all cases the predicted overall efficiency of the complete mode converter system from Sigma TEOn (predominantly TEO3) to HE11 in the desired mode is 90% to 92% (ohmic attenuation is included). Low-power measurements on the efficiency of a 140 GHz TEO1-to-TM11 mode transducer (ao = 13.9 mm) are in excellent agreement with the predicted value of 95.2% (including ohmic attenuation). ESA

N86-29133# Stuttgart Univ. (West Germany). Inst. fuer Plasmaforschung.
OPTIMIZATION OF WALL PERTURBATIONS IN RIPPLED WALL MODE CONVERTERS FOR OVERMODED CIRCULAR WAVEGUIDE
M. Thumm, G. A. Mueller, and R. Wilhelm *In its* Improved Mode Converters for Generating the HE11 (Near-Gaussian) Mode from Gyrotron TEOn Modes at 70 GHz and 140 GHz Nov. 1985 p 10-17 (For primary document see N86-29131 20-33)
Avail: NTIS HC A02/MF A01

Considerable improvement (higher efficiency, shorter length) of periodic-perturbation mode converters for overmoded circular high-power waveguides was accomplished by changing the perturbation period of the wall slightly from the beat wavelength between the input and the desired output mode, combined with superimposing additional, phase-matched, small perturbations, whose periods correspond to the beat wavelengths between the input and output mode and their related, strongest coupled unwanted modes, respectively. Numerical calculations and measurements on optimization of wall perturbations in TEOn-to-TEO,n-1 mode converters and TEO1-to-TE11 transducers for the 1 MW-ECRH system (five 200 kW/70 GHz-transmission lines with CW capability) at a stellerator are reported. For TEO1-to-TE11 mode conversion in transducers with constant diameter and periodically perturbed curvature (in one plane) multimode calculations show that the efficiency = 86.2% of a simple 8-period 70 GHz transducer can be raised to 97.4%. ESA

N86-29134*# California State Univ., Northridge. Dept. of Engineering.
ANALOG SIMULATION OF FLUX-SUMMING SERVO-MODEL, PHASES 1 AND 2 Final Report, 1 Dec. 1982 - 30 Sep. 1984
Edward J. Hriber Sep. 1984 48 p

(Contract NCA7-OR554-301)
(NASA-CR-176951; NAS 1.26:176951) Avail: NTIS HC A03/MF A01 CSCL 09A

The analog simulation was developed for a closed-loop system having an electrohydraulic flux-summing servo valve and actuator with associated inertial load. One-fourth of the system's total forward gain is carried by each of four channels. The present study successfully applied failure mode management techniques to the problem of channel failure. Digital logic circuitry was developed to maintain the overall forward-gain of the system at a constant value, in the presence of channel failure. Finally, the stability of the system was verified, and performance characteristics were determined through the use of frequency response methods. Author

N86-29135*# National Aeronautics and Space Administration, Washington, D.C.
IMPROVEMENT OF THE PROCESS FOR ELECTROCHEMICAL IMPREGNATION OF NICKEL HYDROXIDE ELECTRODES
M. Comtat, B. Lafage, and J. Leonardi Jul. 1986 12 p Transl. into ENGLISH of "Amelioration du Procede d'Impregnation Electrochimique d'Electrodes d'Hydroxyde de Nickel" rept. ESA-SP-230 presented at the ESA Session of the 16th IEEE Annual Power Electronics Specialists Conference, 1985 p 129-133 Conference held in Toulouse, France, 24-28 Jun. 1985 Original language document was announced as N86-17447 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88469; NAS 1.15:88469; ESA-SP-230) Avail: NTIS HC A02/MF A01 CSCL 09C

Nickel hydroxide electrodes containing 11g/dsqm hydroxide, with capacities of 3.6 to 3.8 Ah/dsqm were prepared at 353 K by electrochemical impregnation. The reproducibility of the results is obtained by readjusting the pH before each preparation. The control of each electrode is done during two cycles of charge and discharge following the manufacture by a potential relaxation method.
Author (ESA)

N86-29136*# National Aeronautics and Space Administration, Washington, D.C.
ELECTRODES WITH FIBER STRUCTURE
G. Benczur-Uermoessy, G. Berger, and F. Haschka Jul. 1986 15 p Transl. into ENGLISH from Elektrotechnische Zeitschrift (West Germany), v. 21, no. 104, 1983 p 1098-1101 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88470; NAS 1.15:88470) Avail: NTIS HC A02/MF A01 CSCL 09C

An electrode framework with a fiber structure, universally applicable in alkaline storage battery systems, was developed and readied for production. Storage batteries with these electrodes present higher energy and power densities and are economical to produce. The design is applicable to all rechargable storage batteries and might replace the previous variety of designs. Author

N86-29137# Rockwell International Corp., Thousand Oaks, Calif. Microelectronics Research and Development Center.
MINIATURE FLAT PANEL DISPLAY FEASIBILITY MODEL Final Technical Report, 1 Jul. 1978 - 30 Sep. 1981
R. D. Ketchpel Nov. 1985 66 p
(Contract DAAK70-78-C-0123)
(AD-A166458; AD-E301928; MRDC41011.60-FR) Avail: NTIS HC A04/MF A01 CSCL 14/2

Development efforts toward producing a matchbox-size miniature TV system using a thin film electroluminescence (TFEL) display are summarized. Potential applications include thermal weapons viewing sight and low mass head-mounted display systems. Results of the program include high density TFEL display surface (692 X 540 pixels at 500 lines/inch density), high density interconnect to display surface, and techniques for fabricating high density polyimide/copper hybrid circuits to provide an integrated miniature display system package. Procurement of high voltage driver ICs was a major hurdle. Upon receipt of these ICs TV imagery was demonstrated on a compact breadboard system using a 320 x 250 pixel TFEL display with 250 lines/inch resolution. Breadboard power measurements indicate a power requirement of 2.4 watts using existing components or 1.7 watts with improvement in the IC driver chip. Author (GRA)

N86-29138# Brookhaven National Lab., Upton, N. Y.
PHOTOVOLTAIC-POWERED SOLID POLYMER ELECTROLYTE (SPE) ELECTROLYZER SYSTEM EVALUATION Final Report
P. D. Metz and M. Piraino Jul. 1985 57 p
(Contract DE-AC02-76CH-00016)
(DE86-005300; BNL-51940) Avail: NTIS HC A04/MF A01

The final results of the evaluation of a photovoltaic-powered solid polymer electrolyte (SPE) electrolyzer system at the Brookhaven National Laboratory (BNL) Hydrogen Technology Evaluation Center (HTEC) are presented. The HTEC facility and the SPE electrolyzer system are described. Electrolyzer test results are then presented. A technoeconomic analysis of hydrogen production via PV-powered electrolysis and other options is reported. The use of grid versus photovoltaic electricity is evaluated parametrically. PV-electrolyzer system transient computer results are presented. The economic model on which the technoeconomic analysis is based is appended, as well as fitting equations and coefficients of some of the test results. DOE

N86-29139# Sandia National Labs., Albuquerque, N. Mex.
RELIABILITY ASSESSMENT OF POLYCARBONATE FILM CAPACITORS
R. V. Baron and D. H. Weingarten 1986 5 p Presented at the Capacitor and Resistor Technology Symposium, New Orleans, La., 11 Mar. 1986
(Contract DE-AC04-76DP-00789)
(DE86-004554; SAND-85-1982C; CONF-860355-1) Avail: NTIS HC A02/MF A01

To assess the reliability of an 18 microfarad, 50-volt rated, metallized-film, polycarbonate capacitor under operating conditions, an experiment was devised and executed which put an array of 500 capacitors into a voltage and temperature matrix for test. This paper describes the capacitor, the experiment and results. DOE

N86-29140# Argonne National Lab., Ill.
DEVELOPMENT AND TEST EVALUATION OF ADVANCED LEAD-ACID BATTERIES FOR LOAD-LEVELING APPLICATIONS
N. P. Yao and J. F. Miller 1986 6 p Presented at the International Symposium on Fuel Cell and Advanced Battery, Tokyo, Japan, 22 Jan. 1986
(Contract W-31-109-eng-38)
(DE86-005565; CONF-860138-3) Avail: NTIS HC A02/MF A01

The Exide load-leveling modules have operated reliably to date in all testing at the NBTL, with stable performance exceeding design goals. Much important information on operation and maintenance requirements has been accumulated in over 3 1/2 years of testing to date. It is concluded that these batteries can perform load-leveling applications for electric utilities or utility customers. DOE

N86-29141# Sandia National Labs., Albuquerque, N. Mex.
INVERTED RELATIVISTIC MAGNETRON WITH A SINGLE AXIAL OUTPUT
W. P. Ballard, L. M. Earley, and C. B. Wharton (Cornell Univ., Ithaca, N.Y.) Jan. 1986 70 p Prepared in cooperation with Cornell Univ., Ithaca, N.Y.
(Contract DE-AC04-76DP-00789)
(DE86-005853; SAND-85-1952) Avail: NTIS HC A04/MF A01

A twelve vane, 1 MV, S-band magnetron has been designed and tested. An inverted design was selected to minimize the parasitic axial electron losses. The stainless steel anode is approximately one wavelength long. One end is partially short-circuited to RF, while the other end has a mode transformer to couple the 3.16 GHz (PI)-mode out into a TM sub 01 circular

waveguide. The magnetron has a loaded output Q of about 100. Operation at 1 MV, 0.31 T, 5 kA routinely produces approx. 150 MW peak rms and 100 MW average rms with pulse lengths adjustable from 5 to 70 ns. The microwave power pulse has a rise time of approx. 2 ns. The output power is diagnosed using four methods: calorimetry, two circular-waveguide directional couplers installed on the magnetron, two transmitting-receiving systems, and gaseous breakdown. Operation at other voltages and magnetic fields shows that the oscillation frequency is somewhat dependent on the magnetron current. Frequency changes of approx. 20 MHz/kA occur as the operating conditions are varied. A series of experiments varying the anode conductivity, the electron emission profile, and the output coupling transformer design showed that none of these significantly increased the output power. Therefore, we have concluded that this magnetron operates in saturation. Because of the anode lifetime and repeatability, this magnetron has the potential to be repetitively pulsed. DOE

N86-29142# Allied Bendix Corp., Kansas City, Mo.
DEVELOPMENT OF FABRICATION TECHNIQUES FOR A 32-IN. DIAMETER EXPLOSIVE-DRIVEN GENERATOR
R. L. Finney Jan. 1986 24 p
(Contract DE-AC04-76DP-00613)
(DE86-006157; BDX-613-3340) Avail: NTIS HC A02/MF A01

Tooling and fabrication techniques for helical-wound generator coils as large as 31 inches in diameter have been demonstrated. The coil conductors were 0.125 in. at the input and increased to 0.500 in. at the output of the generator. The coil was encapsulated with a filled epoxy system. DOE

N86-29143# Los Alamos National Lab., N. Mex.
DESIGN OF PULSE TRANSFORMERS FOR ISOLATION PROTECTION AND HIGHER SPEEDS IN THE REMOTE FIRING OF BRIDGE WIRES
W. H. Bostick, B. L. Freeman, J. C. King, and A. R. Martinez Jan. 1986 15 p
(Contract W-7405-eng-36)
(DE86-007581; LA-10586-MS) Avail: NTIS HC A02/MF A01

The continued development of high-performance explosive pulsed power supplies has necessitated the development of high-voltage isolated x-unit systems. We have developed a circuit involving an x-unit, a step-up transformer, a pulse-forming network, a step-down transformer, and a bridge wire. With this circuit, the time to burst a single bridge wire was reduced from 0.6 (MU)s for a direct, short x-unit connection to 0.21 (MU)s while obtaining an x-unit-to-bridge wire isolation of greater than or equal to 180 kV. DOE

N86-29144# Sandia National Labs., Albuquerque, N. Mex.
FIBER-OPTIC DIAGNOSTIC FOR ENERGY MEASUREMENTS
G. L. Lockwood, D. J. Muron, L. E. Ruggles, J. Chang, D. D. Bloomquist, and S. R. Babcock 1986 13 p Presented at the Conference on Measurement of Electrical Quantities in Pulse Power Systems-2, Gaithersburg, Md., 5 Mar. 1986
(Contract DE-AC04-76DP-00789)
(DE86-007834; SAND-85-1482C; CONF-860384-2) Avail: NTIS HC A02/MF A01

A fiber-optic diagnostic system based on calorimetry to measure the total energy deposited in a liquid-filled load resistor is developed. Thermodynamic calculations show the fluid temperature to come to equilibrium in about two seconds and to remain there for several tens of seconds. Thus fluid temperature can determine the energy deposited. Using a fluoroptic thermometer, the change in temperature of a copper sulfate solution load resistor was measured as a function of the energy stored in a capacitor bank. A comparison of these results with the calculated temperature rise shows agreement to + or - 3% over the energy range from 1.4 kJ to 5.9 kJ. Measurements were then made of the energy deposited in a sodium chloride solution load resistor on the Ripple accelerator. These were made as a function of energy stored in the Marx generator from 7.4 kJ to 21.2 kJ. Electrical measurements of the energy deposited were made at the same time. These were high on the average by 8%. DOE

N86-29145# Lawrence Livermore National Lab., Calif.
LASER FABRICATION OF INTERCONNECT STRUCTURES FOR CMOS GATE ARRAYS
J. C. Whitehead, F. Mitlitsky, D. J. Ashkenas, A. F. Bernhardt, S. E. Farmwald, J. L. Kaschmitter, and B. M. McWilliams 1986 11 p Presented at the Symposium and Exhibition on Optical and Electro-optical Engineering, Los Angeles, Calif., 19 Jan. 1986
(Contract W-7405-eng-48)
(DE86-008143; UCRL-94057; CONF-860117-7) Avail: NTIS HC A02/MF A01

Maskless, automated, five minute interconnection of a 1000 gate CMOS array die has been accomplished using discretionary laser-induced chemical vapor deposition. Eight 125-stage ring oscillators written on single CMOS gate array dies were shown to have the device-limited performance of similar patterns manufactured with a photolithographically patterned aluminum-silicon alloy. These results suggest the feasibility of using this method, Laser Pantography (LP), for rapid implementation of prototype and limited volume semi-custom VLSI circuits immediately after their design is completed. DOE

N86-29146# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France). Div. Systemes Balistiques et Spatiaux.
MANUFACTURING OF HARDENED ELECTRICAL WIRING [REALISATION DE LIAISONS ELECTRIQUES DURCIES IEM]
Hublet, Meytrueix, Deve, Degelle, and Raveu 11 Dec. 1985 57 p In FRENCH
(SNIAS-861-430-112; ESA-86-97174) Avail: NTIS HC A04/MF A01

The quality control and manufacturing procedures required to assure the high reliability of electrical wiring systems for aerospace or weapon applications are discussed. The means of increased protection from electromagnetic interference include interference filters, peak absorption devices, and improved grounded shields. The use of magnetostriction devices in cable assembly is recommended. Shield manufacturing technology is discussed. Quality control facilities are detailed. It is shown that the wiring hardening techniques must be a part of the design stage to avoid later problems. ESA

N86-29147# Commerce Dept., Washington, D.C.
AMPLIFICATION BY A PHASE LOCKED ARRAY OF JOSEPHSON JUNCTIONS Patent Application
D. G. McDonald, (inventor to Commerce Dept.) Filed 26 Nov. 1985 23 p
(US-Patent-Appl-SN-801972) Avail: NTIS HC A02/MF A01 CSCL 09E

The object of the invention is to provide a general purpose amplifier, using Josephson junctions, which has a wide bandwidth and sufficiently high impedance to allow connection to a large variety of signal sources and which requires only a dc power source. GRA

N86-29258*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONTACT-RESISTANCE PROCESS CLIFF
Cesar A. Pina *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 7 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 14D

N86-29259*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ADDRESSABLE INVERTER MATRIX FOR PROCESS AND DEVICE CHARACTERIZATION
Martin G. Buehler and Hoshyar R. Sayah *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 7 p Repr. from Solid State Technology, May 1985 p 185-191 Previously announced in IAA as A86-16549 (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 14D

N86-29261*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
JMOSFET: A MOSFET PARAMETER EXTRACTOR WITH GEOMETRY-DEPENDENT TERMS
Martin G. Buehler and B. T. Moore *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 42 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 09A

N86-29262*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE 1.2 MICRON CMOS TECHNOLOGY
Cesar A. Pina *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 10 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 09C

N86-29263*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TEST CHIP ASSEMBLER AND TEST PROGRAM GENERATOR
Cesar A. Pina *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 6 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 09C

N86-29264*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FAULT MODELS
Hoshyar R. Sayah and Martin G. Buehler *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 p 6 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 09C

N86-29265*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MOS INTEGRATED CIRCUIT FAULT MODELING
M. Sievers *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 15 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 09C

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N86-29148*# California Univ., Los Angeles.
THE NON-NEWTONIAN HEAT AND MASS TRANSPORT OF He 2 IN POROUS MEDIA USED FOR VAPOR-LIQUID PHASE SEPARATION Ph.D. Thesis
Sidney W. K. Yuan 1985 222 p
(Contract NCC2-305)
(NASA-CR-177075; NAS 1.26:177075) Avail: NTIS HC A10/MF A01 CSCL 20D

This investigation of vapor-liquid phase separation (VLPS) of He 2 is related to long-term storage of cryogenic liquid. The VLPS system utilizes porous plugs in order to generate thermomechanical (thermo-osmotic) force which in turn prevents liquid from flowing out of the cryo-vessel (e.g., Infrared Astronomical Satellite). An apparatus was built and VLPS data were collected for a 2 and a 10 micrometer sintered stainless steel plug and a 5 to 15 micrometer sintered bronze plug. The VLPS data obtained at high temperature were in the nonlinear turbulent regime. At low temperature, the Stokes regime was approached. A turbulent flow model was developed, which provides a phenomenological description of the VLPS data. According to the model, most of the phase separation data are in the turbulent regime. The model is based on concepts of the Gorter-Mellink transport involving the mutual friction known from the zero net mass flow (ZNMF) studies. The latter had to be modified to obtain agreement with the present experimental VLPS evidence. In contrast to the well-known ZNMF mode, the VLPS results require a geometry dependent constant (Gorter-Mellink constant). A theoretical interpretation of the phenomenological equation for the VLPS data obtained, is based on modelling of the dynamics of quantized vortices proposed by Vinen. In extending Vinen's model to the VLPS transport of He 2 in porous media, a correlation between the K*(GM) and K(p) was obtained which permits an interpretation of the present findings. As K(p) is crucial, various methods were introduced to measure the permeability of the porous media at low temperatures. Good agreement was found between the room temperature and the low temperature K(p)-value of the plugs. M.G.

N86-29149*# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
TURBULENT BOUNDARY LAYERS IN OSCILLATING FLOWS. PART 1: AN EXPERIMENTAL AND COMPUTATIONAL STUDY Final Technical Report, 1 Jun. 1982 - 31 Aug. 1985
William J. Cook 10 Feb. 1986 61 p
(Contract NCC2-200)
(NASA-CR-177109; NAS 1.26:177109; ISU-ERI-Ames-86434-Pt-1)
Avail: NTIS HC A04/MF A01 CSCL 20D

An experimental-computational study of the behavior of turbulent boundary layers for oscillating air flows over a plane surface with a small favorable mean pressure gradient is described. Experimental studies were conducted for boundary layers generated on the test section wall of a facility that produces a flow with a mean free stream velocity and a superposed nearly-pure sinusoidal component over a wide range of frequency. Flow at a nominal mean free stream velocity of 50 m/s were studied at atmospheric pressure and temperature at selected axial positions over a 2 m test length for frequencies ranging from 4 to 29 Hz. Quantitative experimental results are presented for unsteady velocity profiles and longitudinal turbulence levels obtained from hot wire anemometer measurements at three axial positions. Mean velocity profiles for oscillating flows were found to exhibit only small deviations from corresponding steady flow profiles, while amplitudes and phase relationships exhibited a strong dependence on axial position and frequency. Since sinusoidal flows could be generated over a wide range of frequency, studies at fixed values of reduced frequency at different axial positions were studied. Results show that there is some utility in the use of reduced frequency to correlate unsteady velocity results. The turbulence level u' sub rms was observed to vary essentially sinusoidally around values close to those measured in steady flow. However, the amplitude of oscillation and phase relations for turbulence level were found to be strongly frequency dependent. Numerical predictions were obtained using an unsteady boundary layer computational code and the Cebeci-Smith and Glushko turbulence models. Predicted quantities related to unsteady velocity profiles exhibit fair agreement with experiment when the Cebeci-Smith turbulence model is used. Author

N86-29150*# Waterloo Univ. (Ontario). Dept. of Applied Mathematics.
ON THE LAGRANGIAN METHOD FOR STEADY AND UNSTEADY FLOW
W. H. Hui and H. J. VanRoessel Feb. 1986 17 p
(Grant NAGw-575)
(NASA-CR-177079; NAS 1.26:177079; WRI-411-29) Avail: NTIS HC A02/MF A01 CSCL 20D

A new and general Lagrangian formulation of fluid motion is given in which the independent variables are three material functions and a Lagrangian time, which differs for different fluid particles and is distinct from the Eulerian time. For steady flow it requires only three independent variables - the Lagrangian time and two stream functions - in contrast with the conventional Lagrangian formulation which apparently still requires four independent variables for describing a steady flow. This places the Lagrangian formulation for steady flow on the same footing as the Eulerian. For unsteady flow, the new formulation includes the

conventional formulation as a special case when the Lagrangian time is identified with the Eulerian time and when the material functions are taken to be the fluid particle's position at some given time. The distinction between the Lagrangian and Eulerian time, however, is found useful in applications, e.g., to problems involving a free boundary. Author

N86-29151*# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
RESPONSE OF HOT ELEMENT FLUSH WALL GAUGES IN OSCILLATING LAMINAR FLOW Final Technical Report, 1 Jun. - 31 Aug. 1986
Timothy A. Giddings and William J. Cook Feb. 1986 129 p
(Grant NCC2-200)
(NASA-CR-177083; NAS 1.26:177083) Avail: NTIS HC A07/MF A01 CSCL 20D

The time dependent response characteristics of flush-mounted hot element gauges used as instruments to measure wall shear stress in unsteady periodic air flows were investigated. The study was initiated because anomalous results were obtained from the gauges in oscillating turbulent flows for the phase relation of the wall shear stress variation, indicating possible gauge response problems. Flat plate laminar oscillating turbulent flows characterized by a mean free stream velocity with a superposed sinusoidal variation were performed. Laminar rather than turbulent flows were studied, because a numerical solution for the phase angle between the free stream velocity and the wall shear stress variation that is known to be correct can be obtained. The focus is on comparing the phase angle indicated by the hot element gauges with corresponding numerical prediction for the phase angle, since agreement would indicate that the hot element gauges faithfully follow the true wall shear stress variation. Author

N86-29152*# California Polytechnic State Univ., San Luis Obispo. Dept. of Aeronautical Engineering.
FLOW DIRECTION MEASUREMENT CRITERIA AND TECHNIQUES PLANNED FOR THE 40- BY 80-/80- X 120-FOOT WIND TUNNEL INTEGRATED SYSTEMS TESTS Final Report, 1 Jan. 1984 - 31 Jul. 1985
Peter Tore Zell, Jon Hoffmann, and Doral R. Sandlin Jul. 1985 71 p
(Contract GNCC2-278)
(NASA-CR-176969; NAS 1.26:176969) Avail: NTIS HC A04/MF A01 CSCL 20D

A study was performed in order to develop the criteria for the selection of flow direction indicators for use in the Integrated Systems Tests (ISTs) of the 40 by 80/80 by 120 Foot Wind Tunnel System. The problems, requirements, and limitations of flow direction measurement in the wind tunnel were investigated. The locations and types of flow direction measurements planned in the facility were discussed. A review of current methods of flow direction measurement was made and the most suitable technique for each location was chosen. A flow direction vane for each location was chosen. A flow direction vane that employs a Hall Effect Transducer was then developed and evaluated for application during the ISTs. Author

N86-29153*# San Diego State Univ., Calif. Dept. of Electrical and Computer Engineering.
MEASUREMENT OF TEMPERATURE AND DENSITY FLUCTUATIONS IN TURBULENCE USING AN ULTRAVIOLET LASER Final Report, Mar. 1981 - Sep. 1984
G. A. Massey Sep. 1984 30 p
(Grant NAG2-104)
(NASA-CR-176972; NAS 1.26:176972) Avail: NTIS HC A03/MF A01 CSCL 20D

Noninvasive measurement of density and temperature fluctuations in turbulent air flow was examined. The approach used fluorescence of oxygen molecules which are selectively excited by a tunable vacuum ultraviolet laser beam. The strength of the fluorescence signal and its dependence on laser wavelength vary with the density and temperature of the air in the laser beam. Because fluorescence can be detected at 90 degrees from the beam propagation direction, spatial resolution in three dimensions, rather than path-integrated measurements can be achieved. With spatial resolutions of the order of a millimeter and at supersonic air velocities it is necessary to perform each measurement in a time of the order of a microsecond; this is possible by using laser pulses of ten nanosecond duration. In this method atmospheric O2 is excited by the emission of a tunable ArF excimer laser, and the fluorescence, which spans the 210 to 420 range, is detected by an ultraviolet phototube. B.G.

N86-29154# National Bureau of Standards, Gaithersburg, Md. Center for Fire Research.
TRANSIENT COOLING OF A HOT SURFACE BY DROPLETS EVAPORATION
M. diMarzo and A. K. Trehan Jul. 1986 132 p
(Grant NBS-70-NAN-85-H-5025)
(NBS-GCR-86-516) Avail: NTIS HC A07/MF A01

The thermal behavior of a hot aluminum surface subjected to cold water droplet impingement is investigated. Evaporation phenomena of a single droplet of pure water is studied for initial surface temperature ranging from 75 to 100 C (implying full suppression of nucleate boiling). The effect of droplet release height, initial surface temperature and, droplet volume on the geometrical configuration of the droplet is investigated. A computer model is developed to predict the cooling effect (volume of influence) induced by a single droplet in contact with the hot surface, using finite difference techniques. A model to predict the evaporation of water droplets deposited on a hot non-porous solid surface is derived. The water-vapor molar fraction in the air at the exposed surface of the water droplet is deduced from the coupled heat and mass transfer energy balance. Spatial and temporal integration of the overall droplet energy equation is used to predict the droplet evaporation time and the instantaneous evaporation rate. Model predictions agree well with experiments. The model is used to quantify spatial and temporal heat fluxes distribution at the exposed surface of the water droplet. The volume of influence is found to correlate linearly with the evaporation time. This finding is particular important in light of the modelling of multi-droplets cooling effects. Author

N86-29155*# National Bureau of Standards, Gaithersburg, Md. Temperature and Pressure Div.
STABILITY OF SOME EPOXY-ENCAPSULATED DIODE THERMOMETERS
B. W. Mangum and G. A. Evans, Jr. Feb. 1986 99 p
(Contract NASA Order-L-83949B)
(NASA-CR-178137; NAS 1.26:178137; NBSIR-86-3337) Avail: NTIS HC A05/MF A01 CSCL 20D

The stability upon thermal cycling and handling of ten small, epoxy-encapsulated silicon diode thermometers at six temperatures in the range from liquid nitrogen temperatures to about 60 C. The nominal temperatures of measurement were -196, -78, 0, 20, 40, and 60 C, as measured on the International Practical Temperature Scale of 1968. Diodes were to be thermally cycled 15 to 20 times. Since NASA anticipates that the uncertainty in their temperature measurements will be + or - 50 mK, uncertainties as large as + or - 10 mK in the measurements of the evaluaton can be accommodated without deleteriously affecting the value of the results of the investigation. Author

N86-29156*# Imperial Coll. of Science and Technology, London (England). Dept. of Fluids Section and Mechanical Engrg.
FLOW IN OUT-OF-PLANE DOUBLE S-BONDS
M. C. Schmidt, J. H. Whitelaw, and M. Yianneskis (Kings Coll., London, England) Jun. 1986 67 p
(Grant NAGw-747)
(NASA-CR-176981; NAS 1.26:176981; FS/86/30) Avail: NTIS HC A04/MF A01 CSCL 20D

Developing flows in two out-of-plane double S-bend configurations have been measured by laser-Doppler anemometry. The first duct had a rectangular cross-section 40mmx40mm at the inlet and consisted of a uniform area 22.5 deg. - 22.5 deg. S-duct

upstream with a 22.5 deg.- 22.5 deg. S- diffuser downstream. The second duct had a circular cross-section and consisted of a 45 deg. - 45 deg. uniform area S-duct upstream with a 22.5 deg. -22.5 deg. S-diffuser downstream. In both configurations the ratio of the mean radius of curvature to the inlet hydraulic diameter was 7.0, the exit-to-inlet area ratio of the diffusers was 1.5 and the ducts were connected so that the centerline of the S-duct lay in a plane normal to that of the S-diffuser. Streamwise and cross-stream velocity components were measured in laminar flow for the rectangular duct and in turbulent flow for both configurations; measurements of the turbulence levels, cross-correlations and wall static pressures were also made in the turbulent flow cases. Secondary flows of the first kind are present in the first S-duct and they are complemented or counteracted by the secondary flows generated by the area expansion and by the curvature of the S-diffusers downstream. Cross-stream velocities with magnitudes up to 0.19 and 0.11 of the bulk velocity were measured in the laminar and turbulent flows respectively in the rectangular duct and six cross-flow vortices were evident at the exit of the duct in both flow cases. The turbulent flow in the circular duct was qualitatively similar to that in the rectangular configuration, but the cross-stream velocities measured at the exit plane were smaller in the circular geometry. The results are presented in sufficient detail and accuracy for the assessment of numerical calculation methods and are listed in tabular form for this purpose. Author

N86-29157# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

CALIBRATION AND DATA REDUCTION FOR A FIVE-HOLE PROBE

C. S. Lee and N. J. Wood Jun. 1986 40 p

(JIAA-TR-73) Avail: NTIS HC A03/MF A01 CSCL 20D

An experimental investigation was conducted to study a five-hole probe in low speed flow. The probe was a 0.125-in diameter tube with a hemisphere tip, the central hole was located at the tip of the probe, the four side holes were symmetrically located at 30 deg. with respect to the probe axes. Calibrations were conducted in the Stanford low speed wind tunnel at two typical speeds. The data reduction was performed by double interpolations using spline curve fitting. The calibration and data reduction schemes are discussed and analyzed. Results of the five-hole probe measurements in typical three-dimensional vortical flows, including velocity vectors in cross plane, pressure and vorticity contours are presented. Good repeatability is observed. The spatial resolution of the probe is found to be better than 0.05 inches. Author

N86-29158*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

REPORT ON THE FEASIBILITY OF HYPERCUBE CONCURRENT PROCESSING SYSTEMS IN COMPUTATIONAL FLUID DYNAMICS

John Bruno 18 Mar. 1986 72 p

(Contract NCC2-387)

(NASA-TM-89398; RIACS-TR-86.7; NAS 1.15:89398) Avail: NTIS HC A04/MF A01 CSCL 20D

The feasibility of using hypercube-connected concurrent processor systems for problems in computational fluid dynamics is studied. Both explicit and implicit numerical methods are considered and several alternative implementations of these methods are evaluated on concurrent processor systems. A Lax-Wendroff explicit method was designed and implemented for the Navier-Stokes equations. The code runs on the Intel iPSC concurrent processor system. Tests of this code show that it is reasonably efficient. The Beam and Warming implicit factored method was designed and implemented for Berger's equation. Preliminary tests show that the efficiency of code is poor. Author

N86-29159*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

FLOW PAST A FLAT PLATE WITH A VORTEX/SINK COMBINATION

Nikos J. Mourtos Sep. 1984 51 p Previously announced as N85-25215

(Contract NCC2-149)

(NASA-CR-176908; NAS 1.26:176908; JIAA-TR-58) Avail: NTIS HC A04/MF A01 CSCL 20D

An attempt was made to model the so called leading edge vortex which forms over the leading edge of delta wings at high angles of attack. A simplified model was considered, namely that of a two-dimensional, inviscid, incompressible steady flow around a flat plate at an angle of attack with a stationary vortex detached on top, as well as a sink to simulate the strong spanwise flow. The results appear to agree qualitatively with experiments. A comparison was also made between the lift and the drag of this model and the corresponding results for two classical solutions: (1) that of totally attached flow over the plate with the Kutta condition satisfied at the trailing edge only: and (2) the Helmholtz solution of totally separated flow over the plate. M.G.

N86-29160# Rockwell International Corp., Richland, Wash.

PORFLO: A CONTINUUM MODEL FOR FLUID FLOW, HEAT TRANSFER AND MASS TRANSPORT IN POROUS MEDIA. MODEL THEORY, NUMERICAL METHODS AND COMPUTATIONAL TESTS

A. K. Runchal, B. Sagar, R. G. Baca, and N. W. Kline Sep. 1985 104 p

(Contract DE-AC06-77RL-01030)

(DE86-005779; RHO-BW-CR-150-P) Avail: NTIS HC A06/MF A01

Postclosure performance assessment of the proposed high-level nuclear waste repository in flood basalts at Hanford requires that the processes of fluid flow, heat transfer, and mass transport be numerically modeled at appropriate space and time scales. A suite of computer models has been developed to meet this objective. The theory of one of these models, named PORFLO, is described in this report. Also presented are a discussion of the numerical techniques in the PORFLO computer code and a few computational test cases. Three two-dimensional equations, one each for fluid flow, heat transfer, and mass transport, are numerically solved in PORFLO. The governing equations are derived from the principle of conservation of mass, momentum, and energy in a stationary control volume that is assumed to contain a heterogeneous, anisotropic porous medium. Broad discrete features can be accommodated by specifying zones with distinct properties, or these can be included by defining an equivalent porous medium. The governing equations are parabolic differential equations that are coupled through time-varying parameters. Computational tests of the model are done by comparisons of simulation results with analytic solutions, with results from other independently developed numerical models, and with available laboratory and/or field data. In this report, in addition to the theory of the model, results from three test cases are discussed. A users' manual for the computer code resulting from this model has been prepared and is available as a separate document. DOE

N86-29161# Lawrence Livermore National Lab., Calif.

EFFECT OF ROTATION ON RAYLEIGH-TAYLOR INSTABILITY

J. A. Viecelli 15 Jan. 1986 16 p

(Contract W-7405-eng-48)

(DE86-006313; UCID-20638) Avail: NTIS HC A02/MF A01

The effects of viscosity, surface tension, density gradient, and magnetic fields on the growth of the Rayleigh-Taylor instability have been covered in the literature. Rotation has not received as much study, although the case where the rotation axis is perpendicular to the unstable interface has also been analyzed. The combination of rotation with Rayleigh-Taylor instability is an unusual situation, but it may have some interest. Here, the case where the rotation axis is parallel to the interface is analyzed. This case corresponds to fluids contained in a radially expanding or contracting cylindrical shell. The first section gives a derivation for the stability condition for the interface between two thin cylindrical fluid shells under radial acceleration, and the second gives an

example of where rotational effects might be significant in the case of a cylindrical implosion. DOE

N86-29162# Indiana Univ., Bloomington.
CRITERIA FOR THE RELIABILITY OF NUMERICAL APPROXIMATIONS TO THE SOLUTION OF FLUID FLOW PROBLEMS
C. Foias 1986 23 p
(Contract DE-AC02-82ER-12049)
(DE86-007017; DOE/ER-12049/1) Avail: NTIS HC A02/MF A01

The numerical approximation of the solutions of fluid flows models is a difficult problem in many cases of energy research. In all numerical methods implementable on digital computers, a basic question is if the number (N) of elements (Galerkin modes, finite-difference cells, finite-elements, etc.) is sufficient to describe the long time behavior of the exact solutions. It was shown using several approaches that some of the estimates based on physical intuition of N are rigorously valid under very general conditions and follow directly from the mathematical theory of the Navier-Stokes equations. Among the mathematical approaches to these estimates, the most promising (which can be and was already applied to many other dissipative partial differential systems) consists in giving upper estimates to the fractal dimension of the attractor associated to one (or all) solution(s) of the respective partial differential equations. DOE

N86-29163# Sandia National Labs., Albuquerque, N. Mex.
FINITE ELEMENT METHODS IN HEAT TRANSFER
D. K. Gartling Jan. 1986 117 p
(Contract DE-AC04-76DP-00789)
(DE86-007405; SAND-85-1703) Avail: NTIS HC A06/MF A01

The application of the finite element method to problems in conduction and convection heat transfer is described. The formulation of the basic equations is presented and typical solution algorithms for both transient and steady-state problems are described. Example analyses are included for problems in heat conduction, forced convection and free convection. DOE

N86-29164# Sandia National Labs., Albuquerque, N. Mex.
FINITE ELEMENT METHODS FOR NON-NEWTONIAN FLOWS
D. K. Gartling Jan. 1986 97 p
(Contract DE-AC04-76DP-00789)
(DE86-007410; SAND-85-1704) Avail: NTIS HC A05/MF A01

The application of the finite element method to problems in non-Newtonian fluid mechanics is described. The formulation of the basic equations is presented for both inelastic and viscoelastic constitutive models. Solution algorithms for treating the material nonlinearities associated with inealstic fluids are described; typical solution procedures for the implicit stress-rate equations of viscoelastic fluids are also presented. Simple example analyses are included for both types of fluid models. DOE

N86-29165# Nevada Univ., Boulder City. Energy Systems Center.
DEVELOPMENT OF DUAL TEMPERATURE AMMINES FOR HEAT PUMP LATENT HEAT STORAGE APPLICATION Final Report
U. Rockenfeller Mar. 1986 347 p
(Contract DE-AC05-84OR-21400)
(DE86-007887; ORNL/Sub-84-47999/1) Avail: NTIS HC A15/MF A01

Ammoniated Complex Compounds can be used as working fluids in space heating and cooling heat pumps and storage systems. This report describes the theoretical and experimental development of complex compound working fluids for a heat pump-storage system. A computerized data base was developed for the preliminary selection of candidate working fluids. The selected substances were experimentally investigated. Several concepts using two ammoniated complex compounds or one complex compound and the plain ligand were developed. A subscale prototype was built using the NaBr-n NH3 complex and NH3 as the ligand. Two heat exchanger designs were tested and compared in terms of optimum reaction rates. A computer simulation was written to predict the performance of a complex compound heat pump-storage system. The results were compared with a simulation of a conventional R22 heat pump cycle. The influence of additives in the NaBr-n NH3 complex was investigated with respect to the adsorption and desorption rates. DOE

N86-29166# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna.
A METHOD FOR MEASURING TWO-PHASE MASS FLOW USING A TURBINE AND A VENTURIMETER ONLY
Gerald Sonneck, Rudolf Steiner, Peter Windberg, and Laszlo Maroti Sep. 1985 14 p Presented at Specialists Meeting on Small Break LOCA Analasis in LWRs, Pisa, Italy, 23-27 Jun. 1985
(OEFZS-4334; RS-265/85; ESA-86-97069) Avail: NTIS HC A02/MF A01

An air-water loop for steady-state investigations was built. Experiments using a spool piece including a full flow turbine and a venturimeter are described. It is shown that in the given configuration and within the investigated mass flows a turbine and a venturimeter only are sufficient to measure the total mass flow by determining simultaneously gas and liquid mass flows. However, the analysis can only justify qualitatively the measured values so that no extrapolation over a bigger range is possible. The instruments must be calibrated for each desired condition. ESA

N86-29167# Institut de Mecanique des Fluides de Lille (France).
STUDY OF A LOW REYNOLDS FLOW AROUND A CYLINDER: EXPERIMENTAL SET-UP [ETUDE DE L'ECOULEMENT A BAS REYNOLDS AUTOUR D'UN CYLINDRE: MISE EN OEUVRE DE L'EXPERIENCE]
F. Beluche 19 Dec. 1984 30 p In FRENCH
(Contract DRET-83-250)
(Rept-84/70; IMFL-3115; ESA-86-97191) Avail: NTIS HC A03/MF A01

A hydrodynamic tunnel, a flow visualization system, a holographic device, and a laser-Doppler velocimeter provided with a photon correlation system are described. The elements were tested and prove adequate for experiments at 2.5 to 8 cm/sec velocities. ESA

N86-29168# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Aerodynamique.
EXPERIMENTAL STUDY OF TURBULENT THREE-DIMENSIONAL SEPARATION IN FLAT ELLIPSOIDAL CYLINDRICAL MODELS. RESULTS OF THE SECOND WIND TUNNEL TEST CAMPAIGN [ETUDE EXPERIMENTALE DU DECOLLEMENT TRIDIMENSIONNEL TURBULENT SUR MAQUETTES ELLIPSOIDE CYLINDRE APLATI. RESULTATS DE LA SECONDE CAMPAGNE D'ESSAIS A S2CH]
B. Chanetz and C. Quelin Jun. 1985 77 p In FRENCH
(ONERA-RT-11/7252-AN-060-A; ESA-86-97204) Avail: NTIS HC A05/MF A01

Wall flow visualizations and wall pressure distributions for several values of incidence and velocity are presented. The flow distribution was measured using anemometers and a three axes laser velocimeter. The average velocity and the Reynolds tensor were measured at 5000 points around the model. The analysis shows the start and development of vortices. ESA

N86-29169# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
A NONLINEAR LIFTING LINE METHOD FOR THE CALCULATION OF THE FLOW AROUND A ROTATING SYSTEM. PART 1: THE CONVENTIONAL WIND TURBINE
W. J. Piers Mar. 1985 48 p Sponsored by National Development Program on Wind Energy (NOW II) Project Management Bureau for Energy Research
(NLR-TR-85052-L-Pt-1; ESA-86-97404) Avail: NTIS HC A03/MF A01

A nonlinear lifting line method for the calculation of the flow around a wind turbine is presented. The rotor blade is represented by a bound vortex and the vortex wake by isolated vortex filaments of helical form. The influence coefficients of the vortex filaments are computed numerically. The deformation of the vortex wake, in

particular the effect of variation of pitch of the helical vortices and the expansion of the wake, is modeled in an approximate way. Computational results compare reasonably well with experimental data. ESA

N86-29170# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
A NONLINEAR LIFTING LINE METHOD FOR THE CALCULATION OF THE FLOW AROUND A ROTATING SYSTEM. PART 2: THE TIP VANE TURBINE
W. J. Piers Mar. 1985 17 p Sponsored by National Development Program on Wind Energy (NOW II) Project Management Bureau for Energy Research
(NLR-TR-85052-L-Pt-2; ESA-86-97405) Avail: NTIS HC A02/MF A01

A nonlinear lifting line method for the calculation of the flow around a tip vane turbine is presented. The rotor blade is represented by a bound vortex and the vortex wake by isolated vortex filaments of helical form. The tipvane is modeled similarly to the rotor blade. The wake is represented by isolated vortex filaments of helical form, and the vane by a bound vortex. From the perturbation velocities, resulting from this vortex system several contributions to the power coefficient are distinguished. In case of oversynchronization, a method which assures that the vortex filaments fulfil a numerical synchronization condition is introduced. The possibilities of the code for tip vanes comprise the calculation of the aerodynamic characteristics for a given load distribution as well as the corresponding geometry. ESA

N86-29171# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
SECOND ORDER ACCURATE UPWIND SOLUTIONS OF THE TWO-DIMENSIONAL STEADY EULER EQUATIONS BY THE USE OF A DEFECT CORRECTION METHOD
S. P. Spekreijse Sep. 1985 19 p Submitted for publication
(CWI-NM-R8520; B8660188; ESA-86-97508) Avail: NTIS HC A02/MF A01

Finite volume discretization of the steady Euler equations by the finite volume technique is discussed. On an irregular mesh it is shown how to apply Van Leers projection-evolution stages in the discretization. The rotational invariance of the Euler equations is used. For a general numerical flux function, consistent with the physical flux, a proof of the order of accuracy for a first and second order upwind scheme is given. Results hold for all well known approximate Riemann-solvers. Second order accurate approximations are obtained by a defect correction (DeC) method. A limiter, used in the DeC method, is constructed to maintain monotone solutions. For two typical model problems (an oblique shock and a contact discontinuity), only a few (3 or 4) DeC iteration steps are sufficient to steepen discontinuities effectively. This makes the method cheap to apply. The quality of the results seems comparable with results obtained by TVD schemes. ESA

N86-29172# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
DEFECT CORRECTION AND HIGHER ORDER SCHEMES FOR THE MULTIGRID SOLUTION OF THE STEADY EULER EQUATIONS
P. W. Hemker Nov. 1985 20 p Submitted for publication
(CWI-NM-R8523; B8660185; ESA-86-97511) Avail: NTIS HC A02/MF A01

First and second order finite volume schemes for the solution of the steady Euler equations of inviscid flow are described. The solution for the first order scheme can be efficiently computed by a FAS multigrid procedure. Second order accurate approximations are obtained by linear interpolation in the flux or the state space. The corresponding discrete system is solved (up to truncation error) by defect correction iteration. An initial estimate for the second order solution is computed by Richardson extrapolation. Examples of computed approximations are given, emphasizing the effect for the different possible discontinuities in the solution. ESA

N86-29173# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
SHOCK-WAVE BOUNDARY LAYER INTERACTIONS
J. Delery (Office National d'Etudes et de Recherches Aeronautiques, Paris, France), J. G. Marvin (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.), and E. Reshotko (Case Western Reserve Univ., Cleveland, Ohio) Feb. 1986 223 p
(AGARD-AG-280; ISBN-92-835-1519-6) Avail: NTIS HC A10/MF A01

Presented is a comprehensive, up-to-date review of the shock-wave boundary-layer interaction problem. A detailed physical description of the phenomena for transonic and supersonic speed regimes is given based on experimental observations, correlations, and theoretical concepts. Approaches for solving the problem are then reviewed in depth. Specifically, these include: global methods developed to predict sudden changes in boundary-layer properties; integral or finite-difference methods developed to predict the continuous evolution of a boundary-layer encountering a pressure field induced by a shock wave; coupling methods to predict entire flow fields; analytical methods such as multi-deck techniques; and finite-difference methods for solving the time-dependent Reynolds-averaged Navier-Stokes equations used to predict the development of entire flow fields. Examples are presented to illustrate the status of the various methods and some discussion is devoted to delineating their advantages and shortcomings. Reference citations for the wide variety of subject material are provided for readers interested in further study. Author

N86-29068# Royal Military Coll. of Science, Shrivenham (England). School of Management and Mathematics.
PRESSURE WAVE: GUN BARREL INTERACTIONS
A. B. Crowley and W. P. C. King *In* AGARD Interior Ballistics of Guns Jan. 1986 11 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

N86-29071# Ecole Royale Militaire, Brussels (Belgium). Dept. of Applied Chemistry.
INTERIOR BALLISTICS OF SMALL ARMS: PARTICULAR PROBLEMS. PART 1: HEAT TRANSFER AND COOK-OFF PHENOMEN IN A SMALL CALIBER WEAPON
R. Meysmans *In* AGARD Interior Ballistics of Guns Jan. 1986 10 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

N86-29072# Ecole Royale Militaire, Brussels (Belgium). Dept. of Armament and Ballistics.
INTERNAL BALLISTICS OF SMALL ARMS: PARTICULAR PROBLEMS. PART 2: THERMODYNAMIC MODEL, POWDER PARAMETERS, INITIATION
E. Celens *In* AGARD Interior Ballistics of Guns Jan. 1986 23 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

N86-29074# Fraunhofer-Inst. fuer Kurzzeitdynamik, Weil am Rhein (West Germany). Abteilung fuer Ballistik.
MEASUREMENT OF IMPORTANT BALLISTIC FLOW PROPERTIES BY SPECTROSCOPIC TECHNIQUES
Guenter Klingenberg *In* AGARD Interior Ballistics of Guns Jan. 1986 18 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

N86-29075# Concentration Heat and Momentum, Ltd., London (England).
MODELLING THE BEHAVIOUR OF ADDITIVES IN GUN BARRELS
N. Rhodes and J. C. Ludwig *In* AGARD Interior Ballistics of Guns Jan. 1986 11 p (For primary document see N86-29063 20-31)
Avail: NTIS HC A10/MF A01

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N86-29174* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
NEBULIZATION REFLUX CONCENTRATOR Patent
Vernon G. Collins and Wesley R. Cofer, III (College of William and Mary, Newport News, Va.) Issued 17 Jun. 1986 6 p Filed 5 Nov. 1984 Supersedes N85-20154 (23 - 11, p 1615)
(NASA-Case-LAR-13254-1CU; US-Patent-4,595,399;
US-Patent-Appl-SN-668432; US-Patent-Class-55-255;
US-Patent-Class-55-259; US-Patent-Class-55-521;
US-Patent-Class-55-528; US-Patent-Class-261-78A) Avail: US Patent and Trademark Office CSCL 14B

A nebulization reflux concentrator for removing trace gas contaminants from a sample gas is described. Sample gas from a gas supply is drawn by a suction source into a vessel. The gas enters the vessel through an atomizing nozzle, thereby atomizing and entraining a scrubbing liquid solvent drawn through a siphon tube from a scrubbing liquid reservoir. The gas and entrained liquid rise through a concentrator and impinge upon a solvent phobic filter, whereby purified gas exits through the filter housing and contaminated liquid coalesces on the solvent phobic filter and falls into the reservoir. NASA

N86-29175 Deutsche Geodaetische Kommission, Munich (West Germany).
CAMERA CALIBRATION IN PHOTOGRAMMETRIC PRACTICE [KAMMERKALIBRIERUNG IN DER PHOTOGRAMMETRISCHEN PRAXIS]
Guenther Kupfer, ed. and Wilfried Wester-Ebbinghaus, ed. 1985 181 p In GERMAN Conf. held in Bonn, 21-22 Feb. 1985
(Ser-B-275; ISBN-3-7696-8562-8; ISSN-0065-5317;
ESA-86-96925) Copyright. Avail: Issuing Activity

Research on calibration of air cameras for precision photogrammetry is reviewed. Laboratory and field calibrations are compared. Applications of photogrammetric systems are presented (in coal mining, car industry robots, monitoring of churches in subsidence areas). For individual titles, see N86-29176 through N86-29196. ESA

N86-29176 Bonn Univ. (West Germany).
CAMERA CALIBRATION IN PHOTOGRAMMETRIC PRACTICE, INTRODUCTION [KAMMER-KALIBRIERUNG IN DER PHOTOGRAMMETRISCHEN PRAXIS - EINE EINFUEHRUNG]
G. Kupfer *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 7-10 In GERMAN
(For primary document see N86-29175 20-35)
Avail: Issuing Activity

Laboratory, stellar and ground calibrations are developed to assess accuracy and reliability of photographic systems and their components. Calibration of photographic systems is based on analytic assessment systems and software and calibration of aerial images in close-range photogrammetry. Algorithms to obtain simultaneous calibration of photographic systems and aerial images are developed. System reproduction, film printing plate flatness, filter glass plane parallelism, and definition of image plane or image coordinate system are calibrated in laboratory with a visual procedure using goniometers, theodolites and lens/mirror systems. Stellar calibration with or without filters is influenced by emulsion sensitivity. Ground calibration is based on image measurement and geodetic observations. Economical application of the different procedures is assessed. ESA

N86-29177 Zeiss (Carl), Oberkochen (West Germany).
ON ACCURACY OF LABORATORY CALIBRATIONS AND ON AERIAL CAMERA STABILITY WITH THE EXAMPLE OF SPACELAB RMK A 30/23 [UEBER DIE GENAUIGKEIT VON LABORKALIBRIERUNGEN UND DIE STABILITAET VON LUFTBILDKAMMERN AM BEISPIEL DER SPACELAB-RMK A 30/23]
H.-K. Meier *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 11-14 In GERMAN
(For primary document see N86-29175 20-35)
Avail: Issuing Activity

The RMK A 30/23 camera was selected for the Metric Camera experiment on the first Spacelab mission devised to determine laboratory calibration accuracy and RMK stability, based on 1000 high resolution color and black and white measurement images and to determine the applicability of photogrammetric snap shots in 1:100,000 or 1:50,000-scale mapping. Comparison of the calibrations performed in various laboratories with different calibration procedures and instruments shows good homogeneity. Calibrations of RMK A 30/23 before and after Spacelab mission show good geometric quality. The RMK A 30/23 is further improved with forward motion compensation to attain 2x to 10x basic resolution with equal geometric quality. ESA

N86-29178 Joensuu Univ. (Finland).
RADIAL DISTORTION AND COMPONENTS OF DECENTERING DISTORTION IN MODERN AERIAL CAMERAS [RADIALE VERZEICHNUNG UND DIE KOMPONENTEN DER DEZENTRIERUNGSVERZEICHNUNG IN MODERNEN LUFTBILDKAMERAS]
J. Hakkarainen *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 15-24 In GERMAN
(For primary document see N86-29175 20-35)
Avail: Issuing Activity

Radial distortion and decentering distortion of wide-angle cameras were studied. Radial asymmetry is calculated with the calibration results if the reference point is in principal point of autocollimation. Symmetric tangential distortion is determined with a goniometer. Cameras show little distortion (+ or - 2 microns) with a tangential distortion between 1 and 2 mm, good color correction and high geometrical stability. Calibration procedures should be developed to correct very fine distortion values lower than 2 microns with respect to light and standardization, optimization of the calibrating instrument grid, angle measuring system, autocollimation system and observation accuracy for optimal grid intersection. The effects of phase deflection due to energy field on measurement accuracy should be studied. ESA

N86-29179 National Research Council of Canada, Ottawa (Ontario). Photogrammetric Research Section.
ASSESSMENT OF SYSTEM CALIBRATION AND SELF-CALIBRATING PROCEDURE FOR HORIZONTAL IMAGES ABOVE A FLAT AREA BY EXCLUSIVE APPLICATION OF GIVEN CONTROL POINTS [BEWERTUNG VON SYSTEMKALIBRIERUNG UND SELBSTKALIBRIERUNGSVERFAHREN FUER SENKRECHTBILDER UEBER FLACHEM GELAENDE BEI AUSSCHLIESSLICHER VERWENDUNG GEGEBENER PASSPUNKTE]
H. Ziemann *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 25-47 In GERMAN
(For primary document see N86-29175 20-35)
Avail: Issuing Activity

A mathematical model for definition of lens distortion, geometrical and optical parameters, and on iteration procedure was developed to study camera calibration with horizontal images above a flat test field. The procedure is applied to calibrate small photogrammetric blocks. The image coordinates are applied in bundle adjustment with self-calibration. A comparison between self-calibration procedures and a system calibration based on image coordinates corrected against image distortion shows the inability of self-calibration models to detect the effects of noncorrected image errors. A model of the rotation-symmetrical distortion through components of a power series is necessary and a procedure for a more efficient correction of image distortion should be developed. Results confirm that with larger blocks fewer control points are necessary. ESA

N86-29180 Ecole Polytechnique Federale de Lausanne (Switzerland).
COMPARATIVE ANALYSIS OF CAMERAS [VERGLEICHENDE ANALYSE VON AUFNAMEKAMMERN]
O. Koelbl *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 48-64 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

Image quality and metric precision for Zeiss Jena LMK with automatic forward motion compensation, Wild Heerbrugg RC 10A, and Zeiss Oberbrocken RMK are analyzed. Image quality is analyzed using modulation transmission function under flight conditions and metric precision with aerotriangulation of a photogrammetric block (6 lines: 7 images). The test field and the photographic mission are described. Field measurements show better image quality than laboratory measurements. Comparison of the results on Panatomic-X Film and Plus-X Film show little enhancement of measurement accuracy with increased resolution capacity. ESA

N86-29181 Technische Univ., Hanover (West Germany).
INVESTIGATIONS OF SYSTEMATIC IMAGE DEFECTS NOT TAKEN INTO ACCOUNT IN AEROTRIANGULATION [UNTERSUCHUNG NICHT BERUECKSICHTIGTER SYSTEMATISCHER BILDFEHLER BEI AEROTRIANGULATIONEN] **c43**
K. Jacobsen *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 65-71 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

The procedures for investigation of residual systematic image defects in calculation of the residue mean values and in covariance analysis of block adjustment with or without self-calibration are described. The investigations are performed on a computer system with programs for bundle block adjustment. The differences between the mathematical model of central perspective and film geometry are due to self-calibration of additional parameters in a bundle block adjustment. ESA

N86-29182 Bonn Univ. (West Germany).
PRACTICAL SYSTEM CALIBRATION IN THE FIELD [PRAKTISCHE SYSTEMKALIBRIERUNG IM FELD]
G. Kupfer, S. Zinndorf, W. Schaefer, and H. Roessmann *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 72-82 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

Field calibration of camera systems for aerial image measurements based on a refined functional and/or stochastic model of photogrammetry to check possible and economical application of full or partial calibration according to the ground conditions is introduced. The camera is secured in a fixed position on an aircraft. Simulation calculations give satisfactory calibration results in flight for a wide-angle camera. Systems can be fully and economically calibrated in adequate field configuration. Introduction of weighted laboratory calibration values can improve the result and the numerical resolution of equation systems. In high mountains, conditions for full calibration are more favorable. Ideal perequisites for automatic calibration are given. ESA

N86-29183 Technische Univ., Hanover (West Germany).
COMBINED ADJUSTMENT WITH VARIANCE COMPONENT ASSESSMENT AND SIMULTANEOUS CALIBRATION [KOMBINIERTE AUSGLEICHUNG MIT VARIANZKOMPONENTENSCHAETZUNG UND SIMULTANKALIBRIERUNG]
E. Kruck *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 83-94 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

Combined adjustment and simultaneous calibration of geodetic observations based on test calibrations and on comparison between theoretical results from a photogrammetric geodetic adjustment program and the test results are studied. The program Bundle Adjustment for Engineering Purposes is used to assess functional closeness of the program to reality, to compare geodetic and photogrammetric observations, and adjust object point coordinates on images. A network adjustment program based on eignevalues is used to analyze networks with geodetic network observations. Simultaneous calibration is recommended for image curvatures. Combined adjustment is more efficient to control the total network through a flawless functional model than a bundle adjustment taking into account that covariance of control points for variance components cannot be assessed from total network. Relationships between radial weigting function and camera type should be investigated. ESA

N86-29184 Bonn Univ. (West Germany).
PARAMETER ASSESSMENT IN HYBRID OBSERVATIONS INCLUDING SYSTEM CALIBRATION [PARAMETERSCHAETZUNG BEI HYBRIDEN BEOBACHTUNGEN UNTER EINSCHLUSS DER SYSTEMKALIBRIERUNG]
S. Zinndorf *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 95-99 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

The internal orientation parameters of a camera during a flight over an opencast mining area for close range photogrammetry were calibrated using bundle adjustment program PAT-B and adjustment program MOR-S. The distance network including control points is compared with MOR-S. Distance measurements and photogrammetric data are compared in a hybrid total block and the camera system is calibrated for accuracy. Comparison shows worse defect mean values in X-axis and Y-axis for the total block than for the opencast mining block. ESA

N86-29185 Joensuu Univ. (Finland).
GONIOMETER TO CALIBRATE SYSTEM CAMERAS OR AMATEUR CAMERAS [GONIOMETER FUER DIE KALIBRIERUNG VON SYSTEM- UND ANDEREN AMATEUR-KAMERAS]
J. Hakkarainen *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 100-105 In GERMAN Sponsored by Finnish Akademie der Wissenschaften and Joensuu Univ. (For primary document see N86-29175 20-35)
Avail: Issuing Activity

An accurate and rapid horizontal goniometer was developed to determine the optical properties of film cameras. Radial and decentering distortion, color defects, optical resolution, and small object transmission factors are measured according to light wavelengths and symmetry. The goniometer can be used to calibrate cameras for photogrammetry, to determine the effects of remoteness on image geometry, distortion symmetry, efficiency of lens lighting film systems, to develop quality criteria for lenses, and to test camera lens and camera defects after an incident. ESA

N86-29186 Technische Univ., Hanover (West Germany).
METHODS FOR FIELD CALIBRATION OF CLOSE-RANGE PHOTOGRAMMETRIC CAMERAS [VERFAHREN ZUR FELDKALIBRIERUNG VON PHOTOGRAMMETRISCHEN AUFNAHMEKAMMERN IM NAHBEREICH]
W. Wester-Ebbinghaus *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 106-114 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

Field calibration methods in close range photogrammetry are studied with respect to internal camera orientation and simultaneous system calibration. Configurations for calibration determination of the projection center location in the image, of the camera constant, and image main point through orientation of a single image; image variant internal orientation with additional scale; expanded object with spatial single control point; convergent shots; calibration over a plain control point field; and four-plate shots are illustrated. The methods can be improved with data on directions and distances. ESA

N86-29187 Bonn Univ. (West Germany).
RADIAL DISTORTION IN THE REPRODUCTION OF THREE-

DIMENSIONAL TARGETS AT CLOSE RANGE [RADIALSYMMETRISCHE VERZEICHNUNG BEI ABBILDUNG DREIDIMENSIONALER OBJEKTE IM NAHBEREICH]
G. Kupfer *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 115-120 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

Radial distortion in the reproduction of 3D targets in close range photogrammetry is studied based on Seidel series where distortion is a function of radial distance. Radial distortion depends on object remoteness and camera focusing. Distortion is programmed for MOR-S program (and adjustment program). Test field photographs are used to determine the test field coordinates. ESA

N86-29188 Technische Univ., Hanover (West Germany).
OPERATIONAL TEST FIELD CALIBRATIONS AT THE INSTITUTE OF PHOTOGRAMMETRY AND SURVEYING, HANOVER [OPERATIONELLE TESTFELDKALIBRIERUNGEN AM INSTITUT FUER PHOTOGRAMMETRIE UND INGENIEURVERMESSUNGEN IN HANNOVER]
H. Heier *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 121-124 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

Cameras for medium and small size image formats were studied for accuracy of test field calibration with respect to camera internal orientation (camera constant, coordinates of the image main point and radial-symmetrical distortion parameters). The calibration images are assessed on a Planicomp C-100 with an HP computer. The program concentrates on automatic rough positioning of the points to be measured so that the operator can concentrate on point research, selection or identification. Image points are transformed with a correction function. The calibration values are calculated through bundle adjustment with the multi-image orientation adjustment program MOR. Good accuracy is obtained. ESA

N86-29189 Bonn Univ. (West Germany).
THE MOR-S PHOTOGRAMMETRIC GEODETIC ADJUSTMENT PROGRAM IN SPARSE MATRIX TECHNIQUE [MOR-S, EIN PHOTOGRAMMETRISCH-GEODAETISCHES PROGRAMM IN SPARSE-TECNIK]
L. Hinsken *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 125-133 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

The MOR-S (multi-image orientation) a bundle adjustment program, used in geodesy networks, based on sparse matrix technique for resolution of normal equation systems with multi-unknown parameters is applied to assess Gauss-Markov model parameters (external and internal orientation parameters and error parameters). Operation of MOR-S through envelopes or profile storage techniques is described. Numerical examples with multiple unknowns, envelope, bandwith and reordering are presented to show storage reduction due to unknown factor ordering in normal equation systems. The system computing time is reduced upon reduction, resolution, and inversion. ESA

N86-29190 Bonn Univ. (West Germany).
BASILICA DI SAN FRANCISCO: AN EXAMPLE FOR SIMULTANEOUS FIELD CALIBRATION OF SEVERAL CAMERA SYSTEMS [BASILIKA DI SAN FRANCISCO - EIN BEISPIEL ZUR SIMULTANEN FELDKALIBRIERUNG MEHRERER AUFNAHMESYSTEME]
R. Kotowski *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 134-141 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

Photographs of a church taken with various lenses were used to study bundle adjustment with simultaneous field calibration of camera systems. Simultaneous field calibration allows the introduction of internal orientation parameters in adjustment procedures. Point coordinate deviation from adjustment with simultaneous calibration of a 350mm lens is 1.5 cm. Simultaneous calibration can be applied to avoid inaccuracy in image point coordinates. The interactions between image and object space geometry and target coordinate accuracy are studied. An economical and practical photogrammetric procedure based on simultaneous calibration and application of the partial measuring camera principles can be developed. ESA

N86-29191 Bonn Univ. (West Germany).
CALIBRATION OF A TERRESTRIAL MEASURING CAMERA SYSTEM BASED ON THE EXAMPLE OF A CHURCH IN A MOUNTAINOUS SUBSIDENCE AREA [KALIBRIERUNG EINES TERRESTRISCHEN MESSKAMMER-SYSTEMS AM BEISPIEL DER AUFNAME EINER KIRCHE IM BERGSENKUNGSGEBIET]
S. Zinndorf *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 142-146 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

Calibration of the Jenoptik universal measuring camera 10/1318 is based on parameters of the camera internal orientation, distortion in X and Z-directions and rotation about Y-axis. Photographs of a church in a mountainous subsidence area are used to determine a 3D point field on the front of the building and to calculate the camera constants with accuracy based on matrices of the free network bundle adjustment. Calibration of the camera system can be done by network adjustment. The camera constants are determined with convergent photographs at two periods or with control point data (coordinates, distances). The main point location is determined with a photograph turning at 200 Gon about the optical axis or with target points. ESA

N86-29192 Technische Univ., Hanover (West Germany).
PRECISION POINT DETERMINATION FOR DISTORTION INVESTIGATION ON MICHAELIS CHURCH IN LUNEBURG (WEST GERMANY) WITH SIMULTANEOUS CALIBRATION OF THE PHOTOGRAMMETRIC SYSTEM [PRAEZISIONSPUNKTBESTIMMUNG ZUR DEFORMATIONSUNTERSUCHUNG AN DER MICHAELISKIRCHE IN LUENEBURG MIT SIMULTANER KALIBRIERUNG DES PHOTOGRAMMETRISCHEN SYSTEMS]
E. Kruck *In* Deutsche Geodaetische Kommission Camera calibration in Photogrammetric Practice 1985 p 147-151 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

Simultaneous calibration of a photogrammetric system including a camera, photographic layer carrier, a developing device and a measuring system to attain a 1 mm accuracy for point determination is applied to measure quantitatively and qualitatively the subsidence movements leading to distortion and damage to a church. The church interior is photogrammetrically represented with points. Photogrammetric observations and conditions and geodetic measurements are compared with the computer system BINGO. A 5mm deviation in eccentricity is noted. All camera unknowns can be accurately determined. Simultaneous calibration of the camera can be performed with high precision with a photogrammetric photograph. Measurements should be performed to determine later damage and actions to be taken to stabilize the church. ESA

N86-29193 Hochschule der Bundeswehr, Munich (West Germany).
SIMULTANEOUS CALIBRATION OF A PARTS MEASURING CAMERA: EXAMPLE OF AN APPLICATION FROM THE CAR INDUSTRY [SIMULTANKALIBRIERUNG EINER TEILMESSKAMMER - EIN ANWENDUNGSBEISPIEL AUS DEM FAHRZEUGAU]
J. Peipe *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 152-158 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

A reflex camera was used for parts measuring in car production lines to determine the bending behavior of the car frame during assembly. Four work stations in the line are represented with spatial point fields through bundle adjustment with simultaneous calibration of the camera. Each image is assessed monoscopically

and the measured points are transformed to correct the systematic image errors. Image triangulation is performed on a computer with a bundle adjustment program. Calibration configurations with photogrammetric data are presented. ESA

N86-29194 Bonn Univ. (West Germany).
CALIBRATION OF A MEASURING CAMERA SYSTEM FOR PRECISE ASSESSMENT OF A NINE SHAFT SEGMENT IN COAL MINING [KALIBRIERUNG EINES MESSKAMMERSYSTEMS ZUR PRAEZISIONSVERMESSUNG EINES SCHACHTSEGMENTS IM STEINKOHLENBERGBAU]
P. Hartfiel *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 159-164 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

A measuring camera was calibrated through bundle triangulation for photogrammetric measurement of sections of a 3.2 m radius, 4.5 m long mine shaft, with an accuracy of 0.2 mm for individual coordinates. The measuring camera is protected against weather. External factors (temperature) influence the components of the camera internal orientation. The interactions between the camera constants and radial-symmetrical distortion are shown. Laboratory and field calibrations are compared. Simultaneous field calibration is required for precision. ESA

N86-29195 Technische Univ., Hanover (West Germany).
CALIBRATION OF A DIGITAL CAMERA SYSTEM [KALIBRIERUNG EINES DIGITALEN AUFNAHMESYSTEMS]
T. Luhmann *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 165-173 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

Calibration of a CCD surface sensor and of a photogrammetric reproduction system is presented. A digital system including a camera with an 80 mm lens, a 120 mm lens for reproduction in the sensor surface, and a CCD camera without lens is calibrated. Analog-to-digital conversion, coordinate measurement, and data transfer are performed. Images are subjected to simultaneous calibration to determine the 3-D target point coordinates of the test field and the internal and external orientation parameters after bundle adjustment. Without previous image processing, accuracy is 10 to 20 micron. The CCD surface sensors can be applied in photogrammetric systems and as sensors for large-scale analog-to-digital conversion of measuring images. Digital image production and processing can be applied in photogrammetric point determination. ESA

N86-29196 Technische Hochschule, Darmstadt (West Germany).
PHOTOGRAMMETRIC PROPERTIES OF FILM CAMERA LINHOF AERO TECHNICA 45 AFTER SIMPLE TRANSFORMATIONS [PHOTOGRAMMETRISCHE EIGNESCHAFTEN DER FILMKAMERA LINHOF AERO TECHNIKA 45 NACH EINFACHEN UMBAUTEN]
G. Berg, A. Bergmann, and B. Wrobel *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 174-181 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

Photogrammetric properties and utility for aerial surveys of a 9 x 12 camera were assessed. Flatness of the image surface and camera internal orientation are studied. The camera was modified to meet photogrammetric requirements. Images are processed using bundle adjustment for field calibration of the camera. The maximum deviation is 2 mm for the spatial coordinates. According to the price-to-performance ratio, the camera is a feasible alternative to other cameras. Further investigations to obtain more accuracy through better image flatness are recommended. ESA

N86-29197*# University of the Pacific, Stockton, Calif. Dept. of Physics.
ANALYSIS OF HOLOGRAPHIC INTERFEROGRAMS OF AERODYNAMIC MODELS IN A WIND TUNNEL Final Report, 1 May 1984 - 31 Dec. 1985
Richard L. Perry 31 Dec. 1985 41 p
(Contract NCC2-298)
(NASA-CR-177006; NAS 1.26:177006) Avail: NTIS HC A03/MF A01 CSCL 14E

Holographic interferometry provides a non-invasive technique for estimating variations in the air density distribution around aerodynamic models in wind tunnels. The testing of this technique has been underway for some time and has been reported previously for a two dimensional aerodynamic model. Results obtained from tests using three dimensional aerodynamic models are summarized. Holograms were made of aerodynamic models in a wind tunnel. Interferograms were made from these holograms. The interference fringes in these holographic interferograms were digitized and this information was entered into the HOLOFT program. The HOLOFT program successfully calculated the known stagnation air density at the nose of a model and the known air density distribution across the cross section passing through the stagnation point for the axisymmetrical case of this model at a Mach number of 0.8. Thus the technique of holographic interferometry does work.The HOLOFT program stands for HOLOgraphic Inversion by 2-D Fourier Transform. Author

N86-29198*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
EVALUATION OF A QUARTZ BOURDON PRESSURE GAGE OF WIND TUNNEL MACH NUMBER CONTROL SYSTEM APPLICATION
William G. Chapin Jul. 1986 19 p
(NASA-TM-88991; NAS 1.15:88991) Avail: NTIS HC A02/MF A01 CSCL 14B

A theoretical and experimental study was undertaken to determine the feasibility of using the National Transonic Facility's high accuracy Mach number measurement system as part of a closed loop Mach number control system. The theoretical and experimental procedures described are applicable to the engineering design of pressure control systems. The results show that the dynamic response characteristics of the NTF Mach number gage (a Ruska DDR-6000 quartz absolute pressure gage) coupled to a typical length of pressure tubing were only marginally acceptable within a limited range of the facility's total pressure envelope and could not be used in the Mach number control system. Author

N86-29199# Argonne National Lab., Ill.
ANL DOPPLER FLOWMETER
H. B. Karplus, A. C. Raptis, S. Lee, and T. Simpson Oct. 1985 87 p
(Contract W-31-109-eng-38)
(DE86-006158; ANL/FE-85-14) Avail: NTIS HC A05/MF A01

A flowmeter has been developed for measuring flow velocity in hot slurries. The flowmeter works on an ultrasonic Doppler principle in which ultrasound is injected into the flowing fluid through the solid pipe wall. Isolating waveguides separate the hot pipe from conventional ultrasonic transducers. Special clamp-on high-temperature transducers also can be adapted to work well in this application. Typical flows in pilot plants were found to be laminar, giving rise to broad-band Doppler spectra. A special circuit based on a servomechanism sensor was devised to determine the frequency average of such a broad spectrum. The device was tested at different pilot plants. Slurries with particulates greater than 70 microns (0.003 in.) yielded good signals, but slurries with extremely fine particulates were unpredictable. Small bubbles can replace the coarse particles to provide a good signal if there are not too many. Successful operation with very fine particulate slurries may have been enhanced by the presence of microbubbles. DOE

N86-29200# Sandia National Labs., Albuquerque, N. Mex.
METHOD FOR YAWSONDE CALIBRATION AND FLIGHT-TEST DATA REDUCTION
W. H. Curry Jan. 1986 59 p
(Contract DE-AC04-76DP-00789)
(DE86-005972; SAND-85-1410) Avail: NTIS HC A04/MF A01

Yawsondes (sun sensors) are used in the flight-testing of rapidly spinning projectiles to determine spin rate and angular orientation

in space. Important to their application is an accurate and reliable method for timing the pulses emitted by their photo cells. By using a digital multiprocessor, timing accuracy within 10 microsecs was achieved in the calibration and data reduction processes. DOE

N86-29201# National Technical Systems, Los Angeles, Calif. Research Div.
EXPLORATION OF HOLOGRAPHIC WINDOW FILM AS AN ANGLE SELECTIVE SOLAR CONTROL FILM Final Report
May 1985 275 p
(Contract DE-AC03-84SF-15294)
(DE86-007811; DOE/SF-15294/T1) Avail: NTIS HC A12/MF A01

The problem of conserving energy by appropriate window design created a strong need for the development of solar control films. This need, as yet, has not been satisfied by existing technologies. The objective of this project is to develop a new technology of IR rejection films which is derived from the rapidly emerging field of optical holography. The concept of windows utilizes Lippmann-Bragg reflection holograms to obtain wide-band filters reflecting IR radiation with very high efficiency. This new technique will provide marked improvement over the performance of existing solar control films. Not only will it allow full transmission of visible light, but it will also have the capability of reflecting nearly all of solar radiation falling in the near IR region. Additionally, because of the optical degress of freedom which holograms provide, the opportunity for angular selective films and even regionally specific holowindows appears possible. DOE

N86-29202# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
IMAGE DATA COMPRESSION WITH SPLINE APPROXIMATION AND SEGMENTATION
J. J. Renes and P. J. dePagter 24 Apr. 1984 12 p Presented at Benelux Information Theory Conference, Aalten, Netherlands, 24-25 May 1985
(Contract NIVR-1874)
(NLR-MP-84043-U; B8660422; ESA-86-97505) Avail: NTIS HC A02/MF A01

An image data compression algorithm based on spline approximation and image segmentation is described. Coding of segmented images is outlined. An image produced by a CDC Cyber 170-855 system is shown. ESA

N86-29203 United Kingdom Atomic Energy Authority, Harwell (England). Instrumentation and Applied Physics Div.
ZIPSCAN: A STATE OF THE ART IN ULTRASONICS
B. J. Smith May 1985 46 p
(AERE-R-11756) Copyright. Avail: Issuing Activity

Many of the data collection, display, analysis and storage functions of ZIPSCAN are discussed. Differences between this type of instrument and conventional ultrasonic instruments are highlighted. There is also a detailed discussion of important features in the specification of the instrument. Author

N86-29082# Joint Publications Research Service, Arlington, Va.
PROPERTIES, APPLICATIONS, FUTURE OF EUROPEAN GYRO SENSORS
Werner Hansli *In its* Europe Report: Science and Technology (JPRS-EST-86-008) 18 Jun. 1986 p 29-32 Transl. into ENGLISH from Wehrtechnik (Bonn, West Germany), Apr. 1986 p 62, 65-66
(For primary document see N86-29079 20-31)
Avail: NTIS HC A06/MF A01

N86-29257*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PINHOLE ARRAY CAPACITOR FOR OXIDE INTEGRITY ANALYSIS
Martin G. Buehler, Brent R. Blaes, Cesar A. Pina, and Thomas W. Griswold *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 7 p Repr. from Solid State Technology, v. 26, no. 11, Nov. 1983 p 131-137 Previously announced in IAA as A84-35500 Sponsored in cooperation with DARPA and NSA
(For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 14D

N86-29299*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OPTICAL DISKS
Brian Lopez-Swafford *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 9 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

36 LASERS AND MASERS

Includes parametric amplifiers.

N86-29204* National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
LONG GAIN LENGTH SOLAR PUMPED BOX LASER Patent
Russell J. DeYoung Issued 10 Jun. 1986 4 p Filed 18 Jun. 1985 Supersedes N86-19596 (24 - 10, p 1581)
(NASA-Case-LAR-13256-1; US-Patent-4,594,720; US-Patent-Appl-SN-745973; US-Patent-Class-372-79) Avail: US Patent and Trademark Office CSCL 20E

A solar pumped laser has its lasing path lengthened by forming a square loop in the lasing path by means of bending mirrors. Solar radiation is collected and concentrated into a donut shaped intensity pattern. This intensity pattern is directed onto the lasing path such that there is a maximum fit of the solar intensity pattern to the square loop laser cavity. NASA

N86-29205# Aerospace Corp., El Segundo, Calif.
THE DEACTIVATION OF HF(V = 3) BY WATER
J. F. Bott 31 Dec. 1985 13 p
(Contract F04701-85-C-0086)
(AD-A165709; TR-0086(6603)-1; SD-TR-85-98) Avail: NTIS HC A02/MF A01 CSCL 20/5

Water is often present as an impurity in HF chemical laser systems and can affect laser performance because of the large HF(1) - H2O deactivation rate coefficient. Diatomic molecules have been found to deactivate the higher vibrational levels of HF(v) with rate coefficients that scale with v as v superscript n where n = 2.7 when the deactivation process is exothermic. This scaling does not hold for HF(v) - H2 collisions in which the primary deactivation process is an endothermic V-V transfer with the endothermicity increasing with v. The room temperature (T = 295 K) deactivation rate of HF (v = 3) by H2O has been measured to be faster than the deactivation rate of HF(v = 1) by H2O by a factor of 3.9. On the basis of a previously reported measurement of the HF(v = 1) - H2O rate coefficient, the deactivation rate coefficient of HF(v = 3) by H2O is estimated to be 16 microseconds/Torr, which is a factor of 3 faster than the hard sphere collision rate. The theoretical implication of this fast-rate coefficient are reviewed. GRA

N86-29206# Texas Univ., Austin. Dept. of Physics.
KINETIC STUDIES FOLLOWING STATE SELECTIVE LASER EXCITATION Progress Report, 15 Mar. 1985 - 14 Mar. 1986
J. W. Keto 1985 22 p
(Contract DE-FG05-84ER-13191)
(DE86-004996; DOE/ER-13191/2) Avail: NTIS HC A02/MF A01

Energy transfer studies using two-photon laser-induced fluorescence are reported. The study includes measurements of radiative life-times and state-to-state deactivation rate constants for the xenon 5 p 6p configuration in collisions with xenon atoms. DOE

N86-29207# Oak Ridge National Lab., Tenn.
OVERHEATING IN SILICON DURING PULSED-LASER IRRADIATION
B. C. Larson, J. Z. Tischler, and D. M. Mills Dec. 1985 7 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985 Prepared in cooperation with Cornell Univ.,

Ithaca, N.Y.
(Contract DE-AC05-84OR-21400)
(DE86-005016; CONF-851217-24) Avail: NTIS HC A02/MF A01

Nanosecond resolution time-resolved X-ray diffraction measurements of thermal strain have been used to measure the interface temperatures in silicon during pulsed-laser irradiation. The pulsed-time-structure of the Cornell High Energy Synchrotron Source (CHESS) was used to measure the temperature of the liquid-solid interface of <111> silicon during melting with an interface velocity of 11 m/s, at a time of near zero velocity, and at a regrowth velocity of 6 m/s. The results of these measurements indicate 110 K difference between the temperature of the interface during melting and regrowth, and the measurement at zero velocity shows that most of the difference is associated with undercooling during the regrowth phase. DOE

N86-29208# Lawrence Livermore National Lab., Calif.
PHYSICS AND DESIGN ISSUES OF A HIGH GAIN FEL
D. Prosnitz 2 Oct. 1985 44 p
(Contract W-7405-eng-48)
(DE86-005445; UCID-20606) Avail: NTIS HC A03/MF A01

A series of viewgraphs is provided that summarize and illustrate some of the physics aspects and design issues of free electron lasers. Physics aspects include the coupling between electrons and light, electron beam properties that affect the free electron laser, and tapering of the wiggler. Design issues include focusing and mismatched electron orbit, as well as diffraction. Modelling of the free electron laser and scaling are also mentioned. DOE

N86-29209# Los Alamos National Lab., N. Mex.
SURFACES IN THE INTERACTION OF INTENSE LONG WAVELENGTH LASER LIGHT WITH PLASMAS
R. D. Jones 1985 15 p Presented at the 2nd International Conference on Surface Waves in Plasmas and Solids, Ohrid, Yugoslavia, 5 Sep. 1985
(Contract W-7405-eng-36)
(DE86-004738; LA-UR-85-4318; CONF-850930-1) Avail: NTIS HC A02/MF A01

The role of surface in the interaction of intense CO2 laser light with plasmas is reviewed. The collisionless absorption of long wavelength light is discussed. Specific comments on the role of ponderomotive forces and profile steepening on resonant absorption are made. It is shown that at intensities above 10 to the 15th power W/sq cm the absorption is determined by ion acoustic-like surface modes. It is demonstrated experimentally that harmonics up to the forty-sixth can be generated in steep density profiles. Computer simulations and theoretical mechanisms for this phenomena are presented. The self generation of magnetic fields on surfaces is discussed. The role these fields play in the lateral transport of energy, the insulation of the target from hot electrons, and the acceleration of fast ions is discussed. DOE

N86-29210# Los Alamos National Lab., N. Mex.
PHOTOFRAGMENT FLUORESCENCE AS AN ANALYTICAL TECHNIQUE: APPLICATION TO GAS-PHASE ALKALI COMPOUNDS
R. C. Oldenborg and S. L. Baughcum 1985 3 p Presented at the International Laser Science Conference, Dallas, Tex., 18 Nov. 1985
(Contract W-7405-eng-36)
(DE86-006030; LA-UR-86-264; CONF-851185-13) Avail: NTIS HC A02/MF A01

Photodissociation of gas-phase compounds using a laser at suitably short ultraviolet wavelengths can produce electronically excited photofragments. Detection of fluorescence from these excited fragments, particularly atomic fragments, allows sensitive and quantitative density measurements while signal strength as a function of dissociation laser wavelength allows differentiation between compounds that yield the same photofragment. Application of the technique to the detection of gas-phase alkali compounds is discussed and the results of experiments to detect sodium and potassium chlorides are presented. DOE

N86-29211# Lawrence Livermore National Lab., Calif.
NEW FREQUENCY CONVERSION MATERIALS FOR HIGH POWER LASERS
S. Velsko and D. Eimerl 18 Dec. 1985 9 p Presented at the Los Angeles Symposium and Exhibition on Optical and Electro-Optical Engineering, Los Angeles, Calif., 19 Jan. 1986
(Contract W-7405-eng-48)
(DE86-006301; UCRL-93810; CONF-860117-2) Avail: NTIS HC A02/MF A01

Material properties relevant for high power harmonic conversion and present information about the linear and nonlinear optical characteristics of some new classes of materials are discussed. An assessment of the possible usefulness of 1-arginine phosphate monohydrate (LAP) as a harmonic generator for high power lasers is given. DOE

N86-29212# Lawrence Livermore National Lab., Calif.
THRESHOLDS MEASURED WITH 350-nm PULSES AT 25 TO 100 Hz FOR BARE POLISHED CRYSTALS OF CaF2 AND FOR SILICA SOL-GEL AR COATINGS ON SILICA SUBSTRATES
M. C. Staggs, D. Milam, I. M. Thomas, and J. G. Wilder 3 Feb. 1986 19 p Presented at the Boulder Damage Symposium, Boulder, Colo., 15 Oct. 1985
(Contract W-7405-eng-48)
(DE86-007117; UCRL-93250; CONF-8510101-7) Avail: NTIS HC A02/MF A01

An XeF laser-damage experiment was used to measure damage thresholds for bare polished crystals of CaF2 and porous silica antireflection coatings on fused silica substrates. Damage was induced by applying 1000 350-nm, 25-ns pulses at repetition rates of 25 to 100 Hz to small (typically 0.12 x .03 cm) sites on the surfaces of the sample. Eight samples of fluorescence-free CaF2 exhibited both surface and bulk damage at fluences as low as 10 J/cm(2). Three samples of UV-grade CaF2 also had surface damage thresholds of 10 J/cm(2), and bulk damage was not observed in this material. Thresholds for the porous silica coatings were 17 to 23 J/cm(2). DOE

N86-29213# Lawrence Livermore National Lab., Calif.
HIGH GAIN AND HIGH EXTRACTION EFFICIENCY FROM A FREE ELECTRON LASER AMPLIFIER OPERATING IN THE MILLIMETER WAVE REGIME
T. J. Orzechowski, B. R. Anderson, W. M. Fawley, D. Prosnitz, E. T. Scharlemann, S. M. Yarema, A. M. Sessler (California Univ., Berkeley. Lawrence Berkeley Lab.), D. B. Hopkins, A. C. Paul, and J. S. Wurtele 1 Oct. 1985 21 p Presented at the 7th International Free-Electron Laser Conference, Tahoe City, Calif., 8 Sep. 1985 Prepared in cooperation with Lawrence Berkeley Lab., Calif.
(Contracts DE-AC03-76SF00098; W-7405-eng-48; MPIR-W3-RPD-53-A127)
(DE86-007154; UCRL-93262; CONF-850956-23) Avail: NTIS HC A02/MF A01

Experiments at the Electron Laser Facility have generated peak microwave power of 180 MW at 35 GHz. The facility is operated as a single pass amplifier. Gain in excess of 30 dB/m has been observed up to saturation of the amplifier. For the 3 MeV, 850 Amp electron beam, the radiation corresponds to 7% energy extraction from the electron beam. Beyond saturation, the electron beam output power exhibits oscillations corresponding to the synchrotron motion of the trapped electrons in the ponderomotive well. In addition, the TE21 and TM21 modes have been studied and have power levels comparable to the fundamental. Third harmonic (105 GHz) radiation has been measured at power levels on the order of a few percent of the peak fundamental power. DOE

N86-29214# Alabama A & M Univ., Normal.
LASER PHOTO ACOUSTIC SPECTROSCOPY Interim Report
P. Venkateswarlu 1986 13 p
(Contract DE-FG05-84ER-13206)
(DE86-008209; DOE/ER-13206/2; IR-2) Avail: NTIS HC A02/MF A01

The entire photoacoustic spectrometer has been designed

and fabricated. Specifications are given for the spectrometer and related equipment. Improvements for the photoacoustic spectrometer are listed. Testing of this entire system is scheduled to be completed by the end of February 1986. DOE

N86-29215# New Mexico State Univ., Las Cruces. Dept. of Physics.
HYDRODYNAMICS OF EVAPORATING AEROSOLS IRRADIATED BY INTENSE LASER BEAMS
R. L. Armstrong, A. Zardecki, and S. A. W. Gerstl 1985 16 p Presented at the 8th International Conference on Lasers, Las Vegas, Nev., 2 Dec. 1985 Prepared in cooperation with Los Alamos National Lab., N. Mex.
(Contract W-7405-eng-36)
(DE86-006016; LA-UR-86-148; CONF-851208-1) Avail: NTIS HC A02/MF A01

An analysis is presented describing the interactions of atmospheric aerosols with a high-intensity laser beam propagating along an atmospheric path. For the case of moderate beam irradiances, diffusive mass transport and conductive energy transport dominate the aerosol-beam interactions. In this regime, the coupled aerosol-beam equations are solved numerically to obtain the spatic-temporal behavior of the propagating beam, and of the irradiated aerosols. For higher beam irradiances, convective transport of mass, energy and momentum away from the irradiated aerosols must be considered. The hydrodynamic equations are solved in the surrounding medium for this regime subject to appropriate jump conditions at the surface of the irradiate aerosol. Numerical examples illustrative of both regimes are given for the case of irradiated water aerosol droplets. DOE

N86-29216# Lawrence Livermore National Lab., Calif.
ACTIVITIES AT LLNL RELEVANT TO GAMMA-RAY LASER CONCEPTS
F. S. Dietrich Feb. 1986 3 p Presented at the International Laser Science Conference, Dallas, Tex., 18 Nov. 1985
(Contract W-7405-eng-48)
(DE86-008153; UCRL-93386; CONF-851185-17) Avail: NTIS HC A02/MF A01

Current and planned gamma-ray laser activities at LLNL include both theoretical and experimental studies of spin and shape isomers, construction of a new accelerator laboratory that will include an optimal facility for gamma-ray laser candidate searches, evaluation of the prospects for developing ultrahigh resolution detectors, and the study of a positron-annihilation laser scheme. Identifying gamma-ray laser candidates will require major advances in both theoretical and experimental techniques for nuclear spectroscopy. We have recently completed a state-of-the art gamma spectrometer that includes a Compton polarimeter and an intrinsic germanium detector with an anticoincidence shield. Shape isomers, which have long lifetimes because they have much larger quadrupole deformations than the ground state, are imbedded in a sea of closely-spaced levels with normal deformation. An experimental facility tailored for gamma-ray laser studies requires beams suitable for producing nuclei near the valley of stability, a flexible beam-chopping system useful for studying lifetimes in the nanosecon d to second range, state-of-the art gamma and conversion-electron spectrometry, and the ability to handle difficult targets that are radioactive or chemically unstable. DOE

N86-29217# National Academy of Sciences - National Research Council, Washington, D. C.
VUV (VACUUM ULTRAVIOLET) AND X-RAY SOURCES FOR ATOMIC AND MOLECULAR SCIENCE Final Report
1986 84 p Report of Workshop held in Washington, D.C., 8-9 Nov. 1984
(Contract DE-FG05-85ER-13326; Grant NSF PHY-84-15232)
(PB86-179520) Avail: NTIS HC A05/MF A01 CSCL 20E

The National Research Council's Committee on Atomic and Molecular Sciences (CAMS) convened a workshop on November 8 to 9, 1984, to review the current status of short-wavelength light sources of interest to the atomic, molecular, and optical (AMO) physics community. The general intent of the Committee was to: (1) review advantages and disadvantages of existing technologies in the ultraviolet (UV) and X-ray spectral range, and (2) determine which of these technologies, if any, is best suited for particular problems in AMO physics. Workshop Papers titles are the following: Atomic and molecular physics with VUV and X-ray photons; Properties of synchrotron radiation from bending magnets, wigglers, and undulators; Partially coherent X-rays from modern storage rings; Lasers in the vacuum ultraviolet and X-ray region; Laser produced plasma light sources; Free electron lasers for the XUV spectral region. GRA

37 MECHANICAL ENGINEERING

Includes auxiliary systems (non-power); machine elements and processes; and mechanical equipment.

N86-29218# Lockheed-California Co., Burbank.
DEVELOPMENT OF AN OPERATING PROFILE FOR AIRCRAFT TIRES Final Report
Paul Durup, Max Gamon, Stephen Bobo (Transportation Systems Center, Cambridge, Mass.), and S. K. Clark (Michigan Univ., Ann Arbor.) Jun. 1986 103 p
(Contract DTRS57-80-C-00190)
(FAA/CT-85-32) Avail: NTIS HC A06/MF A01

The procedures of analysis and dynamometer testing that were used to develop data and supporting technology for improving the maintenance and continued airworthiness of civil aircraft tires are described. As related to the inspection, retread and repair of aircraft tires under Advisory Circular AC 145-41, improved criteria which characterize typical tire operating environments and operating scenarios (associated with long range, medium range, and short haul transport airplanes) are defined. Based upon these criteria and scenarios which include tire loading, temperature, and roll distances, means to assess tire fatigue life were developed. Results of this effort may be used for the identification of in-service acceptance criteria and prescribed retread limits. Author

N86-29219# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
THE SYNTHESIS OF STABLE GRASPS IN THE PLANE
Van-Duc Nguyen Oct. 1985 25 p
(Contracts N00014-80-C-0505; N00014-82-K-0334)
(AD-A165903; AD-E750983; AI-M-862) Avail: NTIS HC A02/MF A01 CSCL 09/2

This paper addresses the problem of synthesizing stable grasps on arbitrary planar polygons. Each finger is a virtual spring whose stiffness and compression can be programmed. The contacts between the finger tips and the object are point contacts without friction. It is proven that all force-closure grasps can be made stable, and it costs O(n) time to synthesize a set of n virtual springs such that a given force-closure grasp is stable. We can also choose the compliance center and the stiffness matrix of the grasp, and so choose the compliant behavior of the grasped object about its equilibrium. The planning and execution of grasps and assembly operations become easier and less sensitive to errors. GRA

N86-29220# Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.
SENSING STRATEGIES FOR DISAMBIGUATING AMONG MULTIPLE OBJECTS IN KNOWN POSES
W. E. L. Grimson Aug. 1985 38 p
(Contracts N00014-80-C-0505; N00014-82-K-0334)
(AD-A165912; AI-M-855) Avail: NTIS HC A03/MF A01 CSCL 12/1

The need for intelligent interactions of a robot with its environment frequently requires sensing of the environment. Further, the need for rapid execution requires that the interaction between sensing and action take place using as little sensory data as possible, while still being reliable. Previous work has developed a technique for rapidly determining the feasible poses

of an object from sparse, noisy, occluded sensory data. This paper examines techniques for acquiring position and surface orientation data about points on the surface of objects, with the intent of selecting sensory points that will force a unique interpretation of the pose of the object with as few data points as possible. Under some simple assumptions about the sensing geometry a technique for predicting optimal sensing positions is derived. The technique has been implemented and tested. To fully specify the algorithm, needed are estimates of the error in estimating the position and orientation of the object, and derived are analytic expressions for such error for the case of one particular approach to object recognition. Author (GRA)

N86-29221# North Carolina State Univ., Raleigh. Precision Engineering Lab.

PRECISION ENGINEERING - SRO 154 Final Report

Thomas A. Dow, Michael D. Bryant, Richard F. Keltie, Clarence J. Maday, and Ronald O. Scattergood Jan. 1986 305 p

(Contract N00014-83-K-0064)

(AD-A166084) Avail: NTIS HC A14/MF A01 CSCL 13/8

For mechanical systems, the basic principles of precision motion have long been clearly enunciated. What is new is the potential for interactive computer use in real-time feedback control, involving: (1) structural stabilization of the instrument or machine; (2) movement and location of its parts; (3) processing of metrology information; and (4) positioning and stabilization of the tool/workpiece interactions in a machine tool. This can lead to a distributed, multivariable, multiloop control problem, with significant computation required in the feedback algorithm. Although the advantages of real-time control have been clear for some time, no complete machine tool or metrology system exploits this with the control of the major variables. At present open loop control is being applied, with corrections for calculated (or previously measured) estimates of systematic errors. Closed loop control automatically corrects for unpredictable errors from factors such as mechanical deflections, thermal deformation, and wear. Once in place, a system for precision manufacture can be used for less exacting tasks, offering reductions of required inspections and assuring part-to-part reproducibility, with reduced rejections. Such a system is at the heart of automated production, yet remains a research area. GRA

N86-29222# Naval Academy, Annapolis, Md. Dept. of Mechanical Engineering.

A REVIEW OF TITANIUM WELDING PROCESSES Final Report, Feb. 1985 - Feb. 1986

D. F. Hasson 3 Feb. 1986 30 p Presented at the TMS/AIME Annual Meeting, New York, N.Y., 26 Feb. 1985

(AD-A166442; USNA-EW-9-86) Avail: NTIS HC A03/MF A01 CSCL 13/8

The efficient and cost-effective utilization of conventional and advanced titanium alloys in structural applications has required the advanced development of several welding processes. These developments have been prompted to a great extent by the high reactivity of titanium as compared to other commonly-welded structural metals, but also by titanium's unique physical and metallurgical properties. This review discusses the current state-of-the-art of welding processes for titanium, concentrating on arc and beam welding processes. Recent advances in processes designed to weld thicknesses ranging from thin sheet to heavy plate are discussed. The presentation deals with advances in the U.S. However, work conducted abroad is also considered. The general conclusion is that the weldability of titanium and its alloys is excellent. As in the welding of any structural metal, the specific application should be examined to select the best welding process. Author (GRA)

N86-29223# Memory Metals, Inc., Stamford, Conn.

REMOTELY OPERABLE SHAPE MEMORY ALLOY SEALS FOR PLASMA CONFINEMENT SYSTEMS

1985 20 p

(Contract DE-AC01-84ER-80195)

(DE86-005206; DOE/ER-80195/T1) Avail: NTIS HC A02/MF A01

The objective of this research program was to demonstrate the feasibility of exploiting vacuum seals fabricated from shape memory alloys as a means of making remotely operable seals. A Ni-Ti shape memory alloy was fabricated by hot isostatic pressing of powder alloy in the form of a rod which was then hot swagged to a 1/4 inch diameter rod. This rod was then formed into a ring and electron beam welded and heat treated. The force generated on recovery of a ring which had been deformed into an elliptical cross was measured and the procedures for clamping in a flange system were studied. Successful vacuum sealing was demonstrated to a level of 10 Torr 1/sec. Design for several closures which are fast action, non-bolt, and potentially capable of remote operation, are presented. DOE

N86-29224# Miami Univ., Coral Gables, Fla.

WASTE HEAT RECOVERY IN A 1600 cc METHANOL FUELED ENGINE

M. R. Swain, P. V. Scott, and M. N. Swain Jan. 1986 34 p

(Contract DE-AC05-84OR-21400)

(DE86-005260; ORNL/Sub-85-27420/1) Avail: NTIS HC A03/MF A01

The results of an experimental and theoretical investigation are presented in this report. The purpose of the investigation was to compare various methods of utilizing methanol as a fuel for reciprocating piston type internal combustion engines. Three different methods of fuel preparation were analyzed. The three methods of fuel preparation were: (1) methanol dissociation with waste heat prior to entering intake manifold; (2) methanol vaporization with waste heat prior to entering intake manifold; and (3) methanol vaporization with waste heat within the cylinder during the compression stroke. The results of the investigation are presented as miles per gallon of methanol for the three fueling methods. DOE

N86-29225# Technical Research Centre of Finland, Espoo.

USE TECHNIQUE OF ALTERNATIVE FUELS IN VEHICLE ENGINES. LITERATURE REVIEW

T. Eklund, N. -O. Nylund, and K. Sipilae Apr. 1985 84 p In FINNISH

(DE86-750278; VTT-TIED-443) Avail: NTIS (US Sales Only) HC A05/MF A01

Different alternatives of running engines used in transport vehicles with substitute fuels are introduced. The introduction is divided into three groups depending on whether one fuel suitable for the process is used, two fuels are used simultaneously or greater modifications are made in the engine to optimize the use of the substitute fuel. The greater changes in the engine, the easier it is to achieve good results in the use of a certain substitute fuel as regards the operation and efficiency of the engine. For example, if neat alcohol is used, better cold-run and wear results are achieved with a dual-fuel system. An even higher efficiency is reached by injecting the alcohol at the compression ratio of the diesel engine directly into the combustion chamber and by igniting it with the aid of a spark. The last-mentioned solution also offers a good so-called multifuel readiness for a car equipped with an engine of this kind. Proper multi-fuel engines have been developed at a lower compression ratio than the diesel engine, using direct injection and spark ignition. These so-called hybrid engines can operate with hydrocarbon fuels that have a wide range of distillation, and with alcohols, only with minor changes in regulations, at a high efficiency and with better cold-start and cold-run properties than the spark ignition engines. These engines are not yet manufactured in series. Gas turbines and stirling engines burning fuel with a continuous flame can also be included in the multi-fuel engines. The use of different fuels (liquid and gaseous) requires minor modifications, and the exhaust gas emission and efficiency properties are good according to research results. However, car versions of these engines are neither yet in serial manufacture. The literature study clearly revealed the scarcity of studies carried out in cold conditions. DOE

N86-29226# Princeton Univ., N. J. Dept. of Mechanical and Aerospace Engineering.
CYCLE-RESOLVED VELOCITY AND TURBULENCE MEASUREMENTS IN AN IC ENGINE WITH COMBUSTION
M. J. Hall, F. V. Bracco, and D. A. Santavicca (Pennsylvania State Univ., University Park.) 1986 12 p Presented at the Society of Automotive Engineering Congress, Detroit, Mich., Feb. 1986
(Contract DE-AC04-81AL-16338)
(DE86-008169; CONF-860263-3) Avail: NTIS HC A02/MF A01

Laser Doppler velocimetry has been used to make cycle-resolved velocity and turbulence measurements in a homogeneous-charge, spark-ignition engine. The engine had a ported intake and disc-shaped chamber with a compression ratio of 8 to 1. It was operated at a speed of 1200 rpm and with a TDC swirl number of 4. A stoichiometric propane-air mixture was used, and ignition was near the wall. The velocity measurements were made at three spatial locations at the midpoint of the clearance height. Tests were made to determine whether the presence of the flame affected the accuracy of the velocity measurements. It was found that the ensemble-averaged mean velocity shows a small deviation, and the rms fluctuation intensity is significantly influenced, but the effects appear to be confined to the flame zone. Data rates were sufficiently high in the preflame and postflame regions to determine the velocity history in each cycle (cycle resolved). The cycle resolved turbulence intensity was found to increase across the flame. The turbulence intensity in the burned gas was found to be homogeneous at the three spatial locations examined and to decay rapidly. There was little or no increase in turbulence intensity ahead of the flame. Author

N86-29227# Oak Ridge National Lab., Tenn. Plant and Equipment Div.
WELDING PROCEDURE SPECIFICATION: GAS TUNGSTEN ARC WELDING OF CHROMIUM-NICKEL STEEL TO NICKEL-CHROMIUM-IRON
C. H. Wodtke, D. R. Frizzell, and W. A. Plunkett Aug. 1985 37 p
(Contract DE-AC05-84OR-21400)
(DE86-001535; ORNL/M-49) Avail: NTIS HC A03/MF A01

Procedure WPS-26-3-ASME-6 is qualified under Section IX of the American Society of Mechanical Engineering (ASME) Boiler and Pressure Vessel Code for gas tungsten arc welding of 300 series Cr-Ni steels (P-8-1) to nickel-chromium-iron (P-43), in thiskness range 0.432 inch; filler metal is ERNiCr-3 (F-43); shielding gas is argon. DOE

N86-29228# Oak Ridge National Lab., Tenn.
CONVERSION OF A SERVOMANIPULATOR FROM ANALOG TO DIGITAL CONTROL
S. M. Killough, H. L. Martin, and W. R. Hamel 1986 20 p Presented at the IEEE International Conference on Robotics and Automation, San Francisco, Calif., 14 Apr. 1986
(Contract DE-AC05-84OR-21400)
(DE86-000090; CONF-860434-1) Avail: NTIS HC A02/MF A01

Oak Ridge National Laboratory (ORNL) has developed expertise in computer control of force-reflecting master/slave servomanipulators as a result of research for the Consolidated Fuel Reprocessing Program. These computer control capabilities have been applied to a commercially available servomanipulator, the TeleOperator Systems SM-229. All of the servo drive and control circuitry has been replaced with commercially available digital controls and amplifiers, and a customer software package has been developed. This conversion to digital computer control resulted in significant improvements in force-reflection characteristics, ease of operation, diagnostic capabilities, indexing features, and potential increased reliability. The system will be used at the Tokamak Fusion Test Reactor at the Princeton Plasma Physics Laboratory (PPPL) for maintenance demonstrations. DOE

N86-29229# Los Alamos National Lab., N. Mex.
APPLICATION OF TELEOPERATOR EXPERTISE TO ROBOTICS
D. L. Grisham and J. E. Lambert 1985 10 p Presented at the Robots Conference, Chicago, Ill., 20 Apr. 1986
(Contract W-7405-eng-36)
(DE86-003659; LA-UR-85-4066; CONF-860487-3) Avail: NTIS HC A02/MF A01

The evolution, capabilities and accomplishments of the Monitor remote handling system are discussed. It is suggested that the equipment and operational expertise can be applied to robotic systems in radioactive and other hostile environments. The Monitor methods of operation, the tooling devised and employed and the applications of these methods to robotic systems are described. DOE

N86-29230# Oak Ridge National Lab., Tenn.
AUTONOMOUS ROBOTS FOR HAZARDOUS AND UNSTRUCTURED ENVIRONMENTS
W. R. Hamel, S. M. Babcock, M. G. Hall, C. C. Jorgenson, S. M. Killough, and C. R. Weisbin 1986 18 p Presented at the Robots Conference, Chicago, Ill., 20 Apr. 1986
(Contract DE-AC05-84OR-21400)
(DE86-005019; CONF-860487-1) Avail: NTIS HC A02/MF A01

This paper reports continuing research in the areas of navigation and manipulation in unstructured environments, which is being carried out at the Center for Engineering Systems Advanced Research (CESAR) at the Oak Ridge National Laboratory (ORNL). The HERMIES-II mobile robot, a low-cost prototype of a series that will include many of the major features required for remote operations in hazardous environments, is discussed. Progress toward development of a high-performance research manipulator is presented, and application of an advanced parallel computer to mobile robot problems, which is under way, is discussed. DOE

N86-29231# Oak Ridge National Lab., Tenn.
ELECTRON BEAM WELDING OF HEAVY-SECTION 3 Cr-1.5 Mo ALLOY
J. F. King, S. A. David, J. E. Sims, and A. M. Nasreldin 1986 34 p Presented at the 67th Annual American Welding Society Meeting, Atlanta, Ga., 13 Apr. 1986
(Contract DE-AC05-84OR-21400)
(DE86-005595; CONF-8604123-1) Avail: NTIS HC A03/MF A01

Electron beam welding is a process that could have advantages for the fabrication of heavy-section steel components such as pressure vessels. The penetrating ability of the beam produces welds with high depth-to-width ratios at relatively high travel speeds, making it possible to weld thick sections with one or two passes without filler metals and other consumables. This paper describes a study that was undertaken to investigate the feasibility of using a high-power electron beam welding machine to weld heavy-section steel of 3 Cr-1.5 Mo-0.1 V alloy. Single-pass welds were made in 102-mm thick (4 in.) plates of this alloy. The main emphasis of this work was concentrated on determining the mechanical properties of the resulting weldment, characterizing the microstructure of the various weldment regions, and comparing these results with those from other welding processes. All characterization testing showed that the electron beam weldment in 3 Cr-1.5 Mo-0.1 V steel had excellent properties either matching or exceeding those of the base metal and weld metal from submerged arc welding and shielded metal arc welding processes. DOE

N86-29232# Oak Ridge National Lab., Tenn.
INVERSE DYNAMICS POSITION CONTROL OF A COMPLIANT MANIPULATOR
M. G. Forrest-Barlach and S. M. Babcock 1986 33 p Presented at the IEEE International Conference on Robotics and Automation, San Francisco, Calif., 14 Apr. 1986
(Contract DE-AC05-84OR-21400)
(DE86-001333; CONF-860434-2) Avail: NTIS HC A03/MF A01

The cycle time of typical industrial manipulators is limited by vibrational characteristics associated with drive train compliance. In this paper the effects of drive train compliance and actuator dynamics in a two-degree-of-freedom manipulator are modeled and a position controller based on inverse dynamics is developed. For comparison, independent joint control neglecting compliance and independent joint control including actuator dynamics and drive

train compliance are also considered. Simulation of various controllers is performed utilizing the Advanced Continuous Simulation Language. It is shown that the closed loop frequency response of the manipulator can be increased beyond typical industrial practices by considering the drive train compliance in the design and providing suitable feedback measurements. Simulations suggest that satisfactory performance can be obtained as high as the limit imposed by the manipulators unmodeled higher vibration modes. The controller based on inverse dynamics is shown to effectively decouple the manipulator's nonlinearly coupled degrees of freedom and perform better than a linear independent joint controller which also considers drive train compliance. DOE

N86-29233# Fermi National Accelerator Lab., Batavia, Ill.
DESIGN CHARTS FOR VACUUM PLATES
J. E. OMeara Jan. 1986 10 p
(Contract DE-AC02-76CH-03000)
(DE86-008119; FNAL-TM-1052-A) Avail: NTIS HC A02/MF A01

This paper presents design charts to aid designers in selection of a wall thickness for flat plates used on vacuum vessels. These charts display both stress and deflections for a given wall thickness and plate dimensions. Since both stress and deflection are plotted on a single graph, one may select the proper wall thickness quite readily. Precautions for use of the charts are also presented. DOE

N86-29234# Lawrence Livermore National Lab., Calif.
VARIABLE STRUCTURE MODEL FOLLOWING CONTROL DESIGN FOR ROBOTICS APPLICATIONS
K. D. Young Feb. 1986 17 p Presented at the IEEE International Conference on Robotics and Automation, San Francisco, Calif., 14 Apr. 1986
(Contract W-7405-eng-48)
(DE86-008136; UCRL-94074; CONF-860434-6) Avail: NTIS HC A02/MF A01

The increased demand on robotic system performance leads to the use of advanced control strategies. In this paper a variable structure model following control design is proposed for robotics applications. DOE

N86-29235 United Kingdom Atomic Energy Authority, Harwell (England). Materials Development and Engrg. Projects Div.
COMPOSITE/METAL JOINTING TECHNOLOGY FOR VEHICLE WEIGHT REDUCTION Summary Report
D. T. Livey and J. C. McCarthy Dec. 1985 21 p
(AERE-R-12020) Copyright. Avail: Issuing Activity

A comprehensive program of work was carried out on the development and validation of design procedures for adhesively bonded composite-metal joints. Two computer programs were developed for the design of turbular joints (e.g., driveshafts) and sheet-sheet joints (e.g., for bodywork) which take account of the extensive yielding of adhesives in stressed joints. Associated materials, testing and assessment work included the determination of adhesive and joint mechanical properties required for the validation of the design stress analyses. A materials data base for future use in joint design was established. Test methods were developed to provide more reliable and accurate data on adhesive properties. Environmental durability and surface treatment combinations on joint components; testing of full size component joints for drive shafts and hatchback doors under both static and fatigue loads; and a preliminary assessment of non-destructive testing techniques are discussed. Author

N86-29236# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.
AIRCRAFT AND BEARING TRIBOLOGICAL SYSTEMS
Loughton, England Feb. 1986 232 p Meeting held in San Antonio, Tex., 22-26 Apr. 1985
(AGARD-CP-394; ISBN-92-835-1509-9) Avail: NTIS HC A11/MF A01

Advances in aircraft gear and bearing tribology are discussed. Future trends and problems, gear and bearing materials, and lubricants are discussed. For individual titles, see N86-29237 through N86-29254.

N86-29237# Westland Helicopters Ltd., Yeovil (England).
THE VALUE OF LABORATORY SIMULATION TESTING FOR PREDICTING GEARBOX PERFORMANCE
P. B. Macpherson *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 11 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

The evolution of a successful gearbox design involves much development testing which is both time consuming and expensive. For this reason full advantage should be taken of laboratory simulation tests for which, to be successful, predictions must, obviously, be reliable. Some of the more salient aspects of simulation testing are set out along with a few examples drawn from the author's experience. Heat treatment design rules, future test methods, and testing machines are discussed. Author

N86-29238# Schaefer (Georg) and Co., Schweinfurt (West Germany).
EFFECTS OF UNFAVORABLE ENVIRONMENTAL CONDITIONS ON THE SERVICE LIFE OF JET ENGINE AND HELICOPTER BEARINGS
Hans-Karl Loroesch *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 9 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

Aircraft bearings normally operate at high speeds and have to meet demanding reliability requirements. If conventional guidelines for their design are used, the resultant stresses are low. The stresses are particularly low if compared to those customarily applied in testing rolling fatigue. Potential fatigue life, the influence of plastic deformation in the raceways, the influence of surface damage and loading, service life under favorable lubricating conditions, achievable fatigue life at loads above the endurance limit, and the influence of contamination are discussed. Author

N86-29239# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
AERO-ENGINE GEARS: MANUFACTURING CRACKS AND THEIR EFFECT ON OPERATION
J. Specht *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 10 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

The effect of cracks in gear splines is discussed. After black-oxidising of case-hardened gears, stress corrosion cracking may occur. This was determined from damage analysis of cracked gears of flight engines and from sample testing. Besides design measures to reduce operational stresses, corrective action may be in the form of modified manufacturing procedures and improved crack inspection. Author

N86-29240# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Stuttgart (West Germany). Inst. for Technical Physics.
TRIBOLOGY IN AIRCRAFT SYSTEMS: BASIC PRINCIPLES AND APPLICATIONS
E. Jantzen and V. Buck *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 13 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

The historical origin of the name tribology is outlined. The trends for the next two decades are reviewed: reduction of fuel consumption, improvement of the ratio of specific output to weight, reduction of maintenance, and further improvement of safety. Then the consequences from these trends are outlined with respect to research in tribology. The current status of research is sketched and some unsolved problems are discussed: interaction of material/lubricant in areas with mixed friction (reaction layers); interaction of material/lubricant in the hydrodynamic region; friction and wear of synthetic bearings with and without lubrication; friction, wear and service time if solid lubricants are used; and topographical

features of surfaces. Many government sponsored research to gain the wide spread of basic knowledge necessary for new and better solutions. Author

N86-29241# Schaefer (Georg) and Co., Schweinfurt (West Germany).
DESIGN AND CALCULATION OF HIGH SPEED ENGINE BEARINGS
H. J. Koeber *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 12 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

New aspects in design and calculation of high speed ball and roller bearings are discussed in as much as they affect bearing performance in the speed range of DxN = 3.0 x 1 million min-1 and beyond. For roller bearings the guide flange to roller end configuration as well as roller excursion within the cage pocket are linked to the phenomena of skewing and skidding. The need for under-race-lubrication in small diameter engine bearings is derived from this and a special solution (integral scoop) is shown along with related performance data. The influence of incorporating state of the art rolling elements made of silicon nitride on the design and calculation of high speed ball and roller bearings is shown taking into account hardness, density, Young's modulus and the Poisson ratio. Increase speeds coupled with additional design features being incorporated (such as lubrication holes, grooves, slots) require that inner rings of improved fracture toughness be developed with existing materials of known properties thus supplementing the material development activities already under way. Author

N86-29242# Boeing Vertol Co., Philadelphia, Pa.
A STUDY OF THE POTENTIAL BENEFITS ASSOCIATED WITH THE DEVELOPMENT OF A DEDICATED HELICOPTER TRANSMISSION LUBRICANT **c27**
Raymond J. Drago, Pasquale J. Mangione (Naval Air Propulsion Test Center, Trenton, N.J.), and Raymond D. Wendrzycki *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 11 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

A common oil is now used in both the engines and transmissions of virtually all U.S military helicopters. While this provides significant logistic advantages, these advantages are attained only by compromising the optimization of the oil for either system. The results of two studies undertaken to determine what benefits would accure through the development of a special oil tailored specifically to meet the unique requirements of high-speed, heavily loaded helicopter transmission systems are summarized. These studies, conducted independently by two major helicopter manufacturers under the direction of the Naval Air Propulsion Center, addressed specific problem areas as related to typical production aircraft in order to reach well-documented conclusions. In addition, the effect of the availability of such a special gearbox lubricant on the development of other advanced-technology components was evaluated and documented. Author

N86-29243# KHD Luftfahrttechnik G.m.b.H., Oberursel (West Germany).
MULTIFUNCTIONAL REQUIREMENTS FOR A GEARBOX SECONDARY POWER SYSTEM IN A MODERN FIGHTER AIRCRAFT AND ITS COMPONENTS AND INTERFACE REQUIREMENTS
Manfred Pucher *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 14 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

The basic task of the gearbox in a Secondary Power System (SPS) of an aircraft is to provide and distribute mechanical energy from the Auxiliary Power Unit (APU) or from the Main Engine (ME) to the accessories, e.g., generators, hydraulic pumps and fuel pumps. The complexity as well as the functional facilities increase by incorperating further functional requirements such as main engine start, cross drive operation between redundant systems with the associated control devices, including oil supply to the accessories into the gearbox oil system. The Tornado-SPS is one of the most modern systems flying today. The system shows a high reliability although the aircraft has been in service for only a few years. The experience gained with major components like gearbox housing, gearing, freewheel clutches, dry friction cluthes and components of the oil system is reported. Some aspects from this experience are given for the design of gearboxes for future secondary power systems. Author

N86-29244# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (West Germany).
REQUIREMENTS ON LUBRICATIN OIL FROM THE VIEW OF A HELICOPTER MANUFACTURER **c27**
Joachim Hartmann and Wolfgang Jonda *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 6 p (For primary document see N86-29236 20-37)
Avail NTIS HC A11/MF A01

Experience with known oil types, used in helicopters for transmissions, engines, hydraulics and brakes has shown that 3 main conditions if available, would improve drastically the performance of the aircraft. These 3 main conditions are: the same type of oil should be usable for all the above mentioned systems; the oils brands, produced according to a common specification, but by different manufacturers, should be mixable without restrictions; and some features of the oil, which are specially important for helicopter operations, should be improved. Author

N86-29245# Army Materials and Mechanics Research Center, Watertown, Mass. Physical Metallurgy Branch.
DIRECTION OF R AND D AND CURRENT STATUS OF UNDERSTANDING OF ADVANCED GEAR STEELS **c26**
P. J. Fopiano, J. E. Krzanowski, and G. M. Crawford *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 15 p (For primary document see N86-29236 20-37)
Avail NTIS HC A11/MF A01

High performance gears in the modern helicopter must operate at ever increasing torque and RPM. A major consequence of this increased torque and RPM is a significant increase in the surface temperature and increased scuffing of the gears. In response to this problem, Boeing-Vertol introduced a new class of steel (hot work tool steel) as a high performance aircraft gear steel and started a trend which all subsequent work has confirmed to be a correct decision. The three most prominent candidate critical high temperature aircraft gear steels including Vasco X-2M, CARTECH X-53 (PYROWEAR 53), and CBS600 are discussed. The heat treatment responses of these alloys will be compared. Three additional alloys (M50NiL, CBS1000M, and AMAX B) are discussed in less detail. Author

N86-29246# Westland Helicopters Ltd., Yeovil (England). Materials Lab.
THE ROLE OF RESIDUAL STRESS IN THE PERFORMANCE OF GEARS AND BEARINGS
A. V. Olver *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 16 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

Residual stresses are an inevitable consequence of the manufacture and service conditions to which mechanical components are subjected. A wide range of evidence is presented to show the decisive effect of residual stress, both pre-existing and service induced, on the performance of gears and rolling element bearings. The results of measurement of residual stresses arising from a range of manufacturing procedures are presented, particular emphasis being placed on carburized steels. The effect of such stresses on fatigue performance is demonstrated. Possible causes of residual stress change during service are reviewed and the results of new experimental and theoretical work on the role of residual contact stress in a number of relevant tribological failure modes are presented. Author

N86-29247# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Mechanical Engineering.
THE LUBRICATION OF DYNAMICALLY LOADED CONCEN-

TRATED HARD LINE CONTACTS: TEMPERATURE AND PRESSURE MEASUREMENTS
M. J. W. Schouten, H. J. vanLeeuwen, and H. A. Meijer *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 12 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

Some results of temperature and pressure measurements in two types of dynamically loaded concentrated contacts are reported, viz., a cam-flat follower contact and a cylindrical roller - outer race contact. The measurement technique utilizes miniature vapour deposited thin layer transducers and a counter current circuit and an amplifier. These first results are very encouraging. The transducers worked well, even under very adverse conditions of pure sliding and dynamic loads. Author

N86-29248# Atlantic Industrial Research Inst., Halifax (Nova Scotia).
WEAR OF HIGH SPEED ROLLER BEARINGS
T. Savaskan, E. E. Laufer (Nova Scotia Technical Coll., Halifax.), and D. E. Veinot (Defence Research Establishment Atlantic, Dartmouth, Nova Scotia) *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 12 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

A laboratory bearing test rig was constructed to study wear in three high-speed roller bearings simultaneously under different conditions of loading and lubrication. A test run of 355 hours duration was performed during which wear of the bearings was monitored using DR ferrography. The test bearings from the rig were examined using metallography and microhardness measurements. Wear debris particles were collected from oil samples using ferrography. These were studied using bichromatic microscopy, scanning electron microscopy and energy dispersive X-ray analysis. The results of ferrography were correlated with the metallographic results. Author

N86-29249# Air Force Aero Propulsion Lab., Wright-Patterson AFB, Ohio.
MILITARY AIRCRAFT PROPULSION LUBRICANTS: CURRENT AND FUTURE TRENDS c27
G. A. Beane, IV, Lois J. Gschwender, Carl E. Snyder, Jr., and John T. Shimski (Naval Air Propulsion Test Center, Trenton, N.J.) *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 16 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

An assessment of the performance of MIL-L-7808J and MIL-L-23699C Military Specification lubricating oils in turbine engines and helicopter gear boxes is presented along with predicted performance of current and upgraded military specification oils in advanced and growth engine designs. Data is presented on advanced ester base engine lubricants, corrosion inhibited engine oils, and separate helicopter gear box oils evolving from current developmental research efforts. Future high temperature candidate fluids representing the ultimate stability for turbine engine oils are also discussed. Their use, in most cases, entails engine design considerations to accommodate their unique properties. The advantages and disadvantages of the various classes of synthetic lubricants for turbine engine applications are discussed, and deficiencies are identified where additional research programs are needed. Author

N86-29250# Imperial Coll. of Science and Technology, London (England).
FUTURE TRENDS IN HELICOPTER TRANSMISSION LUBRICANTS c27
H. A. Spikes *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 10 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

Some recent fundamental studies relating to the lubrication of helicopter transmissions are presented, as well as implications for future oil development. The resulting enhanced understanding of lubrication mechanisms has shown that real potential exists both for improved performance and for the ability to cater to higher temperatures, by means of the formulation and use of improved transmission oils. If such benefits are recognized and if the new knowledge is correctly applied, there is no reason why helicopter gearbox reliability should not be appreciably improved by the end of the decade. Author

N86-29251# Motoren- und Turbinen-Union Muenchen G.m.b.H. (West Germany).
AIRCRAFT ENGINE OILS AND THEIR BEHAVIOUR AT HIGH TEMPERATURES c27
K. Maier *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 12 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

Characteristics of aero-engine oils are changed considerably under high-temperature conditions (> 200 to 250 C). Consequences of this are the formation of aging products and deposits, deficiences in the tribological behavior and spontaneous ignition, in extreme cases. The problems arising from these are illustrated using several selected examples, and their effects on engine functioning are described. Author

N86-29252# Air Force Wright Aeronautical Labs., Wright-Patterson AFB, Ohio.
PERFORMANCE MODELLING: A TOOL FOR LUBRICANT DEVELOPMENT c27
Howard E. Bandow *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 11 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

A basic requirement for the development of lubricants and aerospace fluids is to understand the physical properties of these fluids required to optimize performance of the lubricated system. Computer models have been used to predict the effects of lubricant properties on rolling element bearing performance. Studies were performed to validate models, to predict performance under various operating conditions, and to predict the effects of proposed design or lubricant changes on system performance. The results of some of these studies are described and compared with experimental measurements. Models which predict traction forces in lubricated contacts from thermal and rheological properties of the lubricant and bearing materials, and the geometry and operating conditions of the contact are compared with experimental results from a two disk traction device with a micro-computer based control/data acquisition system. The capabilities of models with the ability to predict the performance of hydraulic systems, the components making up these systems and lubricated contacts within the components are described and the methodology of studies to determine required fluid properties discussed. Author

N86-29253# Technische Univ., Munich (West Germany).
SCORING TESTS OF AIRCRAFT TRANSMISSION LUBRICANTS AT HIGH SPEEDS AND HIGH TEMPERATURES c27
H. Winter and K. Michaelis *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 9 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

Aircraft engines always contain gears that have to be lubricated under conditions of high speeds and extremely high temperatures. In this field of application scoring damage is likely to occur. In Europe and partly also in the USA the scoring load capacity of gear oils is expressed in terms of FZG Scoring Load Stage. The FZG Gear Test Rig is described. The normal test procedure A/8.3/90 as standardized in DIN 51 354 using A-type gears at a pitch line velocity of $v = 8.3$ m/s and a starting oil temperature of 90 C is presented. A modified procedure at double speed and increased oil temperature A/16.6/140 is discussed. Because of the high costs and problems with the availability of test gears a modified FZG Ryder Test was developed. The method is presented and comparative results of typical aircraft engine oils in the FZG, the FZG-Ryder and the original Ryder Gear Test are shown. From this experience it becomes obvious that alternative test methods for the evaluation of scoring load capacity of aircraft transmission lubricants can be available in the near future. Author

N86-29254# Blok (Harmen), Rijswijk (Netherlands).
CRITICAL ANALYSIS OF ACHIEVEMENTS AND MISSING LINKS IN GEAR AND BEARING TRIBOLOGY IN RELATION TO POWER ENVELOPES
Harmen Blok *In* AGARD Aircraft and Bearing Tribological Systems Feb. 1986 15 p (For primary document see N86-29236 20-37)
Avail: NTIS HC A11/MF A01

Power envelopes provide a convenient and informative basis of comparison for the development of gear transmissions towards higher power densities. Each such envelope consists of a sequence of segments representing power barriers due to a variety of critical phenomena. Most of these phenomena and barriers are tribologically affected. They may be exemplified by the occurrence of contact between the rubbing surfaces whenever a fully separating lubricant film can no longer be maintained and, further, by pitting and scuffing. For every gear transmission at least two power envelopes have to be considered in conjunction, i.e., for the most vulnerable pair of gears and rolling-element bearing, respectively. The trends of these two envelopes, as well as their mutual position, depend on the configuration of the major elements in the transmission concerned and on certain tribologic characteristics of the solid rubbing materials and the lubricant. The power envelopes, being tribologically affected, prove useful for developing tribology into tribotechnology, so as to enable its integration into the design of gear transmissions. Once certain missing links have been filled in, tribology may provide breakthroughs for developing the technology of both gears and bearings to the high-tech level required for creatively increasing the power densities permissible in gear transmissions. Here, the concentration is upon those segments of the two power envelopes that are called contact barriers. Author

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N86-29255*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PRODUCT ASSURANCE TECHNOLOGY FOR CUSTOM LSI/VLSI ELECTRONICS External Report, Oct. 1982 - Sep. 1984
M. G. Buehler, B. R. Blaes, G. A. Jennings, B. T. Moore, R. H. Nixon, C. A. Pina, H. R. Sayah, M. W. Sievers, and N. F. Stahlberg Jun. 1985 218 p
(Contract NAS7-918)
(NASA-CR-177167; JPL-Publ-85-76; NAS 1.26:177167) Avail: NTIS HC A10/MF A01 CSCL 14D

The technology for obtaining custom integrated circuits from CMOS-bulk silicon foundries using a universal set of layout rules is presented. The technical efforts were guided by the requirement to develop a 3 micron CMOS test chip for the Combined Release and Radiation Effects Satellite (CRRES). This chip contains both analog and digital circuits. The development employed all the elements required to obtain custom circuits from silicon foundries, including circuit design, foundry interfacing, circuit test, and circuit qualification. For individual titles, see N86-29256 through N86-29265.

N86-29256*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
[PRODUCT ASSURANCE TECHNOLOGY EFFORTS: TECHNICAL ACCOMPLISHMENTS]
In its Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 55 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 14D

Product assurance technology topics addressed include: wafer acceptance procedures, test chips, test structures, test chip methodology, fault models, and the Combined Release and Radiation Effects Satellite test chip. B.G.

N86-29257*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PINHOLE ARRAY CAPACITOR FOR OXIDE INTEGRITY ANALYSIS **c35**
Martin G. Buehler, Brent R. Blaes, Cesar A. Pina, and Thomas W. Griswold *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 7 p Repr. from Solid State Technology, v. 26, no. 11, Nov. 1983 p 131-137 Previously announced in IAA as A84-35500 Sponsored in cooperation with DARPA and NSA (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 14D

The integrity of the metal-poly oxide and the gate oxide was evaluated for several 5-micron CMOS-bulk process. The pinhole array capacitor consists of diffused and poly fingers that form a network of MOS transistors (elements), which are capped by a deposited oxide and metal layer. The smallest structure used contained about 15,000 elements and the largest structure contained about 68,000 elements. Each structure was divided into several subarrays. The structures are placed a number of times on each wafer. From a yield analysis of the subarrays, the elements per defect were found to be typically in excess of 50,000 elements/defect for the metal-poly oxide and 100,000 elements/defect for the gate oxide. From the switching behavior of the transistors, the gate oxide defects were tentatively identified as gate-to-body shorts rather than gate-to-diffusion shorts. Author

N86-29258*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CONTACT-RESISTANCE PROCESS CLIFF **c33**
Cesar A. Pina *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 7 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 14D

Several approaches were investigated to obtain a measure of the quality of the contact resistance between metal and a diffused or polysilicon layer. These approaches have included the use of both short and very long contact strings as well as arays of contacts with different sizes to determine the contact resistance process cliff. Results from these approaches are discussed. B.G.

N86-29259*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ADDRESSABLE INVERTER MATRIX FOR PROCESS AND DEVICE CHARACTERIZATION **c33**
Martin G. Buehler and Hoshyar R. Sayah *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 7 p Repr. from Solid State Technology, May 1985 p 185-191 Previously announced in IAA as A86-16549 (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 14D

The addressable inverter matrix consists of 222 inverters each accessible with the aid of a shift register. The structure has proven useful in characterizing the variability of inverter transfer curves and in diagnosing processing faults. For good 3-micron CMOS bulk inverters investigated, the percent standard deviation of the inverter threshold voltage was less than one percent and the inverter gain (the slope of the inverter transfer curve at the inverter threshold vltage) was less than 3 percent. The average noise margin for the inverters was near 2 volts for a power supply voltage of 5 volts. The specific faults studied included undersize pull-down transistor widths and various open contacts in the matrix. Author

N86-29260*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RELIABILITY ANALYSIS
In its Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 24 p Presented at the Spring Meeting of the Electrochemical Society, Inc., San Francisco, Calif., 1983 Sponsored in cooperation with DARPA and NSA (For primary document see N86-29255 20-38)
(Contract NAS7-100)
Avail: NTIS HC A10/MF A01 CSCL 14D

The objective was to search for and demonstrate approaches and concepts for fast wafer probe tests of mechanisms affecting the reliability of MOS technology and, based on these, develop and optimize test chips and test procedures. Progress is reported on four important wafer-level reliability problems: gate-oxide radiation hardness; hot-electron effects; time-dependence dielectric breakdown; and electromigration. B.G.

N86-29261*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
JMOSFET: A MOSFET PARAMETER EXTRACTOR WITH GEOMETRY-DEPENDENT TERMS **c33**
Martin G. Buehler and B. T. Moore *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 42 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 09A

The parameters from metal-oxide-silicon field-effect transistors (MOSFETs) that are included on the Combined Release and Radiation Effects Satellite (CRRES) test chips need to be extracted to have a simple but comprehensive method that can be used in wafer acceptance, and to have a method that is sufficiently accurate that it can be used in integrated circuits. A set of MOSFET parameter extraction procedures that are directly linked to the MOSFET model equations and that facilitate the use of simple, direct curve-fitting techniques are developed. In addition, the major physical effects that affect MOSFET operation in the linear and saturation regions of operation for devices fabricated in 1.2 to 3.0 mm CMOS technology are included. The fitting procedures were designed to establish single values for such parameters as threshold voltage and transconductance and to provide for slope matching between the linear and saturation regions of the MOSFET output current-voltage curves. Four different sizes of transistors that cover a rectangular-shaped region of the channel length-width plane are analyzed. B.G.

N86-29262*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE 1.2 MICRON CMOS TECHNOLOGY **c33**
Cesar A. Pina *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 10 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 09C

A set of test structures was designed using the Jet Propulsion Laboratory (JPL) test chip assembler and was used to evaluate the first CMOS-bulk foundry runs with feature sizes of 1.2 microns. In addition to the problems associated with the physical scaling of the structures, this geometry provided an additional set of problems, since the design files had to be generated in such a way as to be capable of being processed through p-well, n-well, and twin-well processing lines. This requirement meant that the files containing the geometric design rules as well as the structure design files had to produce process-insensitive designs, a requirement that does not apply to the more mature 3.0-micron CMOS feature size technology. Because of the photolithographic steps required with this feature size, the maximum allowable chip size was 10 x 10 mm, and this chip was divided into 24 project areas, with each area being 1.6 x 1.6 mm in size. The JPL-designed structures occupied 13 out of the 21 allowable project sizes and provided the only test information obtained from these three preliminary runs. The structures were used to successfully evaluate three different manufacturing runs through two separate foundries. Author

N86-29263*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TEST CHIP ASSEMBLER AND TEST PROGRAM GENERATOR **c33**
Cesar A. Pina *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 6 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 09C

One of the major problems in working at the geometry level for the generation of either test structure or functional circuit designs is the amount of labor involved in the design phase. To reduce the amount of labor involved in both the design and test of the structures used, JPL has developed a design and test program consisting of a Test Chip Assembler (TCA) and a Test Program Generator (TPG), which creates the geometrical description of the structures and generates the necessary test information using a high-level language. This system reduces the design time for a test chip by a factor of 30. To analyze the data obtained from wafer probing, a statistical package called STMJPL was developed. Some of the capabilities of the JPL software (STMJPL) are described. B.G.

N86-29264*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FAULT MODELS **c33**
Hoshyar R. Sayah and Martin G. Buehler *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 p 6 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 09C

A major problem in the qualification of integrated circuit cells and in the development of adequate tests for the circuits is to lack of information on the nature and density of fault models. Some of this information is being obtained from the test structures. In particular, the Pinhole Array Capacitor is providing values for the resistance of gate oxide shorts, and the Addressable Inverter Matrix is providing values for parameter distributions such as noise margins. Another CMOS fault mode, that of the open-gated transistor, is examined and the state of the transistors assessed. Preliminary results are described for a number of open-gated structures such as transistors, inverters, and NAND gates. Resistor faults are applied to various CMOS gates and the time responses are noted. The critical value for the resistive short to upset the gate response was determined. B.G.

N86-29265*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MOS INTEGRATED CIRCUIT FAULT MODELING **c33**
M. Sievers *In its* Product Assurance Technology for Custom LSI/VLSI Electronics Jun. 1985 15 p (For primary document see N86-29255 20-38)
Avail: NTIS HC A10/MF A01 CSCL 09C

Three digital simulation techniques for MOS integrated circuit faults were examined. These techniques embody a hierarchy of complexity bracketing the range of simulation levels. The digital approaches are: transistor-level, connector-switch-attenuator level, and gate level. The advantages and disadvantages are discussed. Failure characteristics are also described. B.G.

N86-29266# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
AN APPLICATION OF QUALITY CONTROL THEORY TO VENDOR-SUPPLIED PARTS AT AN AEROSPACE MANUFACTURING COMPANY M.S. Thesis
Daniel E. Gellenbeck Aug. 1985 283 p (AD-A166418; AFIT/CI/NR-86-13T) Avail: NTIS HC A13/MF A01 CSCL 05/1

Quality assurance functions at some major industrial manufacturers are confronted with test data on a massive scale and are not capable through manual methods of the indepth analyses that are necessary for effective quality control. This report details the development of a quality control system for use at the Garrett Turbine Engine Company, Phoenix, Arizona, in analyzing the results of testing of vendor-supplied castings and forgings. Traditional quality control chart theory and more elaborate statistical testing, such as analysis of variance, were integrated into the computer programs to produce detailed quality control charts and summaries of data analysis and testing. These programs were integrated into a quality control system to allow management to make more timely and better founded decisions on accepting castings/forgings from vendors, modifying testing plans, and modification of material specifications, thereby reducing costs. The testing results of two selected parts were used to verify operation of the programs. Three example situations were developed to demonstrate the system decision making; primarily comparisons of vendor and

Garret testing of the same casting/forging and/or comparing different vendors. Further improvements were discussed and recommendations made. Although the system was designed specifically for use by Garrett, it could be used by statistically experienced or inexperienced quality assurance personnel in other firms and/or manufacturing disciplines. GRA

N86-29267# Du Pont de Nemours (E. I.) and Co., Aiken, S.C.
CORRELATION OF PINCH WELD STRENGTH WITH ACOUSTIC EMISSION
A. F. Riechman 1985 19 p Presented at the 46th DAMSUL Committee Meeting, Oak Ridge, Tenn., 5 Jun. 1985
(Contract DE-AC09-76SR-00001)
(DE86-008047; DP-MS-85-122; CONF-8506255-2) Avail: NTIS HC A02/MF A01

Acoustic emission (AE) data was collected during the pinch welding of 304L S.S. tubes similar to those used for fill stems on deuterium/tritium gas reservoirs. Attempts to correlate the AE data with welding variables and pinch weld strength were made. This work was done as one element of the Closure (Pinch Weld) Reliability Program. One of five main tasks of this program is to develop an technique to determine pinch weld quality. The main objective is to demonstrate a nondestructive test which is suitable for production use that will ensure high-strength pinch welds. DOE

N86-29268# Societe Nationale Industrielle Aerospatiale, Saint-Medard-en-Jalles (France). Div. Systemes Balistiques et Spatiaux.
TESTING THE QUALITY OF INDUSTRIAL PRODUCTS [QUALITE INDUSTRIELLE AUX ESSAIS]
C. Genty 1986 23 p In FRENCH Presented at colloquium Les Essais: Outils de la Qualite, 15-16 Oct. 1985
(SNIAS-861-430-113; ESA-86-97175) Avail: NTIS HC A02/MF A01

The quality control procedures, management system, and test design criteria adopted by a large aerospace company are reviewed. The whole quality sector is conceived as a separate industry where the product is the control test. All the management principles governing industrial organizations are then extended to quality control. ESA

N86-29269# Societe Nationale Industrielle Aerospatiale, Paris (France).
QUALITY IN THE YEAR 2000: A LINE DIVIDING CALCULATED RISK AND ERROR [LA QUALITE A L'HORIZON 2000: UNE LIGNE DE PARTAGE ENTRE LE RISQUE CALCULE ET L'ERREUR]
Georges Sertour 1986 19 p In FRENCH Presented at 7th AFCIQ Congress on Gestion par la Qualite, Paris, France, 1985
(SNIAS-861-551-102; DCQ-2/85; ESA-86-97177) Avail: NTIS HC A02/MF A01

The quality concepts necessary to the organization and efficiency of an industry are discussed. The construction of quality using available human and knowledge resources; the orientation of investment to provide for higher levels of quality potential; and the control of quality management are considered. Examples from the aerospace industry are given. ESA

N86-29270# Lawrence Livermore National Lab., Calif.
RELIABILITY ANALYSIS OF STIFF VERSUS FLEXIBLE PIPING Final Project Report
S. C. Lu and C. K. Chou May 1985 39 p
(Contract NRC-FIN-A0383)
(TI85-012990; NUREG/CR-4263; UCRL-20410) Avail: NTIS HC A03/MF A01

The overall objective of this research project is to develop a technical basis for flexible piping designs which will improve piping reliability and minimize the use of pipe supports, snubbers, and pipe whip restraints. The current study was conducted to establish the necessary groundwork based on the piping reliability analysis. A confirmatory piping reliability assessment for stiff versus flexible piping systems indicated that removing rigid supports tends, in general, to reduce thermal stress but to increase seismic stress in the pipe. As a result, piping design can be made more reliable by some reduction of rigid supports. It was observed that piping design using snubbers among support devices may not exhibit the intended reliability because snubbers often fail to perform the desired function. It was demonstrated that certain piping systems with snubbers removed actually exhibit higher reliability than do those of the original design. DOE

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N86-29271*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL CLASSICAL FLUTTER REESULTS OF A COMPOSITE ADVANCED TURBOPROP MODEL
O. Mehmed and K. R. V. Kaza Jul. 1986 18 p Presented at the Bisplinghoff Memorial Symposium on Recent Trends in Aeroelasticity, Structures and Structural Dynamics, Gainesville, Fla., 6-7 Feb., 1986; sponsored by Fla. Univ.
(NASA-TM-88792; E-3127; NAS 1.15:88792) Avail: NTIS HC A02/MF A01 CSCL 20K

Experimental results are presented that show the effects of blade pitch angle and number of blades on classical flutter of a composite advanced turboprop (propfan) model. An increase in the number of blades on the rotor or the blade pitch angle is destablizing which shows an aerodynamic coupling or cascade effect between blades. The flutter came in suddenly and all blades vibrated at the same frequency but at different amplitudes and with a common predominant phase angle between consecutive blades. This further indicates aerodynamic coupling between blades. The flutter frequency was between the first two blade normal modes, signifying an aerodynamic coupling between the normal modes. Flutter was observed at all blade pitch angles from small to large angles-of-attack of the blades. A strong blade response occurred, for four blades at the two-per-revolution (2P) frequency, when the rotor speed was near the crossing of the flutter mode frequency and the 2P order line. This is because the damping is low near the flutter condition and the interblade phase angle of the flutter mode and the 2P response are the same. Author

N86-29272*# Stanford Univ., Calif. Guidance and Control Lab.
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF SENSOR LOCATION FOR OPTIMAL AEROELASTIC SYSTEM STATE ESTIMATION Final Report
Gang Liu Sep. 1985 182 p
(Grant NsG-4002)
(NASA-CR-177115; NAS 1.26:177115; SU-SUDAAR-552) Avail: NTIS HC A09/MF A01 CSCL 20K

One of the major concerns in the design of an active control system is obtaining the information needed for effective feedback. This involves the combination of sensing and estimation. A sensor location index is defined as the weighted sum of the mean square estimation errors in which the sensor locations can be regarded as estimator design parameters. The design goal is to choose these locations to minimize the sensor location index. The choice of the number of sensors is a tradeoff between the estimation quality based upon the same performance index and the total costs of installing and maintaining extra sensors. An experimental study for choosing the sensor location was conducted on an aeroelastic system. The system modeling which includes the unsteady aerodynamics model developed by Stephen Rock was improved. Experimental results verify the trend of the theoretical predictions of the sensor location index for different sensor locations at various wind speeds. Author

N86-29273*# Kansas Univ. Center for Research, Inc., Lawrence.
ECONOMIC EVALUATION OF COMPUTERIZED STRUCTURAL ANALYSIS Final Report
Paul E. Fortin Aug. 1985 13 p
(Grant NCC2-251)
(NASA-CR-177078; NAS 1.26:177078) Avail: NTIS HC A02/MF A01 CSCL 20K

This completed effort involved a technical and economic study of the capabilities of computer programs in the area of structural analysis. The applicability of the programs to NASA projects and to other users was studied. The applications in other industries was explored including both research and development and applied areas. The costs of several alternative analysis programs were compared. A literature search covered applicable technical literature including journals, trade publications and books. In addition to the literature search, several commercial companies that have developed computerized structural analysis programs were contacted and their technical brochures reviewed. These programs include SDRC I-DEAS, MSC/NASTRAN, SCADA, SUPERSAP, NISA/DISPLAY, STAAD-III, MICAS, GTSTRUDL, and STARS. These programs were briefly reviewed as applicable to NASA projects. Author

N86-29274*# National Aeronautics and Space Administration, Washington, D.C.
THE MECHANICS OF SOLIDS IN THE PLASTICALLY-DEFORMABLE STATE
R. V. Mises Jul. 1986 19 p Transl. into ENGLISH from Nachrichten von der Koeniglichen Gesellschaft der Wissenschaften (West Germany), 1913 p 582-592 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4004)
(NASA-TM-88448; NAS 1.15:88448) Avail: NTIS HC A02/MF A01 CSCL 20K

The mechanics of continua, which is based on the general stress model of Cauchy, up to the present has almost exclusively been applied to liquid and solid elastic bodies. Saint-Venant has developed a theory for the plastic or remaining form changes of solids, but it does not give the required number of equations for determining motion. A complete set of equations of motion for plastic deformable bodies is derived. This is done within the framework of Cauch mechanics. And it is supported by certain experimental facts which characterize the range of applications. E.R.

N86-29275# Centre de Recherches de l'Inst. Superieur Industriel Catholique du Hainaut (Belgium).
COMPUTER PROGRAMS FOR THE DETERMINATION OF STRESSES AND DISPLACEMENTS IN FOUR LAYERED SYSTEMS WITH FIXED BOTTOM Final Report
F. van Cauwelaert, M. Lequeux, and F. Delaunois Feb. 1986 162 p
(Contracts DAJA45-85-C-0013; DA Proj. 1T1-61102-BH-57)
(AD-A166441) Avail: NTIS HC A08/MF A01 CSCL 13/2

This report deals with the mathematical aspects required for the establishment of a computer program able to calculate all stresses and displacements in a four layered system. The materials of the different layers may be isotropic or anisotropic. The interface conditions cover all the cases from full friction to full slip including partial friction. The bottom of the fourth layer is considered to be fixed (no vertical deflections). The report is based on (1) previous research on isotropic multilayer theory and (2) original research on interface conditions (fixed bottom, partial friction) and satisfactory convergency. This report contains: (1) a theoretical outline wherein the basic equations are given, the specific boundary conditions discussed and the particular numerical problems related to the accuracy at the surface and in the first layer are solved; (2) the general mathematical analysis of the chosen numerical solution and a description of the programs and their utilization; and (3) appendices, detailed mathematical and algebrical analyses for the different considered cases. The programs are written in FORTRAN 77 and run on IBM PC or other compatible equipment. GRA

N86-29276# Australian Atomic Energy Commission, Lucas Heights.
RESULTS OF PIPE BEND ANALYSIS. PART 12: STRESSES IN ELBOWS WITH LONG TANGENTS UNDER OUT-OF-PLANE BENDING
J. F. Whatham May 1985 61 p
(DE86-700535; AAEC/E-605-Pt-12) Avail: NTIS (US Sales Only) HC A04/MF A01

Graphs of outside surface stress distributions are presented and numerical values of stresses on inside and outside surfaces tabulated for a wide range of 90 deg pipe bends with long tangent pipes subjected to out-of-plane bending. The calculations are based on linear thin shell theory. A computer program, BENDPAC, was designed to calculate the stresses in and the flexibility of pipe bends with tangents under in-plane or out-of-plane bending, or flanged pipe bends under any loading. DOE

N86-29277# Ames Lab., Iowa.
PREDICTING INITIATION OF CRACK GROWTH UNDER STRESS CORROSION CRACKING CONDITIONS
R. Ranjan and O. Buck 1985 26 p Presented at the American Society of Mechanical Engineers Winter Annual Meeting, Miami, Fla., 17 Nov. 1985
(Contract W-7405-eng-82)
(DE85-015515; IS-M-550; CONF-851125-20) Avail: NTIS HC A03/MF A01

Under stress corrosion conditions, the major portion of the useful life of a structure is spent in initiation and growth of microcracks, often referred to as the incubation period. Although this period can be a very large fraction of the total time to failure, the prediction of the remaining life of the component during this period is very difficult since there is still a lack of understanding of the processes involved in incubation. To overcome these difficulties, a physical model was developed which, at the present time, is specific to stress corrosion cracking of Cu-30 Zn brass in a nontarnishing ammoniacal solution. The predictions of the model in terms of time to initiation have been tested using experimental data of the effects of applied potential on crack initiation. Coupling of simple nondestructive testing techniques with metallographic observations and scanning electron microscopy provided information on the transition from corrosion pitting to microcrack initiation. Implications of this research on nondestructive evaluation of a component under stress corrosion conditions are discussed. DOE

N86-29278# Stanford Univ., Calif. Div. of Applied Mechanics.
CONSISTENT RETURN MAPPING ALGORITHM FOR PLANE STRESS ELASTOPLASTICITY
J. C. Simo and R. L. Taylor May 1985 31 p Prepared in cooperation with California Univ., Berkeley
(Contract C-W-7405-eng-48)
(DE86-006901; UCB/SESM-85/04) Avail: NTIS HC A03/MF A01

An unconditionally stable algorithm for plane stress elastoplasticity is developed, based upon the motion of elastic predictor return mapping (plastic corrector). Enforcement of the consistency condition is shown to reduce to the solution of a simple nonlinear equation. Consistent elastoplastic tangent moduli are obtained by exact linearization of the algorithm. Use of these moduli is essential in order to preserve the asymptotic rate of quadratic convergence of Newton methods. An exact solution for constant strain rate over the typical time step is derived. On the basis of this solution the accuracy of the algorithm is assessed by means of iso-error maps. The excellent performance of the algorithm for large time steps is illustrated in numerical experiments. DOE

N86-29279# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Dir. Scientifique de la Resistance des Structures.
BOUNDARY LAYER MODEL TO COMPUTE THE EDGE EFFECTS IN STRATIFIED COMPOSITE PLATES Final Report [UN MODELE DE COUCHE LIMITE POUR LE CALCUL DES EFFETS

DE BORD DANS LES PLAQUES STRATIFIEES COMPOSITES]
R. Girard Oct. 1985 21 p In FRENCH
(Contract DRET-84-34-001)
(ONERA-RT-7/3542-RY-041-R; ESA-86-97202) Avail: NTIS HC A02/MF A01

The limit conditions are used to modify the classical solution to satisfy the three dimensional conditions, in order to study a complex stress distribution that could result in composite layer delaminating. The general equations of a zero order model are presented. They reveal the interface complex conditions, which are theoretically simple to solve. The practical solutions are not simple, and the particular cases for which a comparison with analytical solutions is possible, are discussed. ESA

N86-29280# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Dir. Scientifique de la Resistance des Structures.
STRESS APPROXIMATION IN COMPOSITE PLATES Final Report [UNE APPROXIMATION DES CONTRAINTES DANS LES PLAQUES COMPOSITES]
R. Girard Oct. 1985 24 p In FRENCH
(Contract DRET-84-34-001)
(ONERA-RT-27/3043-RY-043-R; ESA-86-97203) Avail: NTIS HC A02/MF A01

A model to describe the stress variations within a composite plate is presented and compared to the exact analytical solution of a flexing plate. The numerical solution follows a modified Hellinger-Reissner principle. The results show that stress and strain in the same plane are correctly approximated while the strain along a transversal plane is not correct. ESA

N86-29281# Technische Hochschule, Darmstadt (West Germany). Fachbereich Mathematik.
A BOUNDARY ELEMENT METHOD FOR THREE-DIMENSIONAL CRACK PROBLEMS
Ernst P. Stephan and Martin Costabel Oct. 1985 11 p Presented at 4th International Symposium on Numerical Methods in Engineering, Atlanta, Ga., 24-28 Mar. 1986
(Grant NSF G-37-634)
(Preprint-941; ESA-86-97428) Avail: NTIS HC A02/MF A01

Boundary integral equations for the Dirichlet and the Neumann crack problem of three-dimensional linear elasticity are presented. It is shown that the crack problem can be reduced to a system of first kind boundary integral equations with the unknown density function being the jump of stresses (in the Dirichlet case) and the jump of the displacements (in the Neumann case) across the crack surface. Existence, uniqueness, and regularity results for the solution of the integral equations are established in appropriate Sobolev spaces. The integral equations are used to derive the asymptotic expansion of their solution showing its singular behavior near the edge of the crack surface. By adding singular elements which simulate this edge behavior to the regular splines as test and trial functions, an augmented Galerkin procedure is performed for the boundary integral equations to obtain an improved rate of convergence for the approximate solution. ESA

42 GEOSCIENCES (GENERAL)

N86-29282*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROCEEDINGS OF THE SECOND PILOT CLIMATE DATA SYSTEM WORKSHOP
1986 268 p Workshop held in Greenbelt, Md., 29-30 Jan. 1986
(NASA-CP-2430; NAS 1.55:2430) Avail: NTIS HC A12/MF A01 CSCL 04B

The proceedings of the workshop held on January 29 and 30, 1986 are discussed. Data management, satellite radiance data, clouds, ultraviolet flux variations in the upper atmosphere, rainfall during El Nino events, and the use of optical disks are among the topics covered. For individual titles, see N86-29283 through N86-29300.

N86-29283*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROGRAM STATUS **c47**
Paul Smith *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 19 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

The Pilot Climate Data System (PCDS) was designed to support a variety of users that have been arbitrarily categorized into four groups: researchers, data producers, occasional users, and management. The expanding capabilities of the system are attracting the attention of both academic and other scientific institutions worldwide. Highlighted by progress in networking capabilities, hardware acquisitions, software developments, data set additions, and tutorial developments, exciting advances have taken place since the First PCDS Workshop. In the plans for the 1986 fiscal year, recommendations from an ad hoc users' group meeting in May 1985 and from the First PCDS workshop are apparent. This year's plans are listed, along with comments made at the users' group meeting. Although the PCDS is presently considered to be in a developmental phase, plans for making the transition to an operational phase are being implemented. Author

N86-29284*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PCDS OVERVIEW **c62**
Lloyd Treinish *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 18 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

A brief overview of the philosophy, design, and organization of the Pilot Climate Data System (PCDS) is presented. The design has evolved, over time, to deal with numerous data sets, provide appropriate tools for the manipulation and display of such data, and support a wide variety of users. The user interface to the system is provided by the Transportable Applications Executive (TAE). A user can choose one of the five major subsystems from the root menu display. These subsystems are CATALOG, INVENTORY, DATA ACCESS, DATA MANIPULATION, and GRAPHICS. Each subsystem was discussed and examples were given, demonstrating the flexibility provided by the existing PCDS software, Version 3.3. Three of these subsystems are presently being redesigned to provide a more flexible and friendly structure, to allow more consistency and facilitate the ability to support new data sets. Ongoing developmental efforts to migrate from the Version 3.3 prototype phase of PCDS to the operational Version 4.0 stress increased flexibility and data independence. Author

N86-29285*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA SET MANAGEMENT **c61**
Mary Reph *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 17 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

The data sets currently supported by the Pilot Climate Data System (PCDS) are listed, many of which are Level II and Level III Nimbus-7 data sets. Those data sets planned for future access through the PCDS were also listed, and their current installation status was stated. The tasks involved in supporting data sets within the PCDS were identified and described. After a data set is approved for implementation into the system and communication with the data producers is established, the information for the detailed catalog entry is gathered. This information then is reviewed with the scientists involved before producing a catalog summary. Once this is done, the catalog information can be provided to users, even before the data set is installed. The next several tasks involve software development and can prove to be the most time-consuming aspect in the data set support. These tasks can be simplified if the data producers provide complete and accurate

documentation of their product. Software for reading and interpreting the data sets is developed and the data sets, or portions therefore, that will be made available for use within the PCDS are inventoried. Users can access this information via the INVENTORY Subsystem of the PCDS. Author

N86-29286*# Science Applications Research, Lanham, Md.
DEMONSTRATION OF NEW PCSD CAPABILITIES c61
Michael Grough *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 8 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

The new, more flexible and more friendly graphics capabilities to be available in later releases of the Pilot Climate Data System were demonstrated. The LIMS-LAMAT data set was chosen to illustrate these new capabilities. Pseudocolor and animation were used to represent the third and fourth dimensions, expanding the analytical capabilities available through the traditional two-dimensional x-y plot. In the new version, variables for the axes are chosen by scrolling through viable selections. This scrolling feature is a function of the new user interface customization. The new graphics are extremely user friendly and should free the scientist to look at data and converse with it, without doing any programming. The system is designed to rapidly plot any variable versus any other variable and animate by any variable. Any one plot in itself is not extraordinary; however, the fact that a user can generate the plots instead of a programmer distinguishes the graphics capabilities of the PCDS from other software packages. In addition, with the new CDF design, the system will become more generic, and the new graphics will become much more rigorous in the area of correlative studies. Author

N86-29287*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
ISCCP REDUCED RESOLUTION SATELLITE RADIANCE DATA c47
William Rossow *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 23 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

The International Satellite Cloud Climatology Project (ISCCP) is the first active project of the World Climate Research Program. It is a multinational data collection project focused on collecting a data set that will improve the ability to predict and/or simulate the radiative effects of clouds on climate. For specified cloud parameters, the goals are to archieve values for 3-hour periods over the whole globe for 5 years at 30 km resolution. The task of collecting and processing radiance data from both geosynchronous and polar orbiting satellites began in July 1983. A diagram was shown illustrating the flow of data from the transmitting satellites to the various receiving institutions that handle it. The various stages of processing were then explained in detail, emphasizing Level B3-normalized, reformatted, reduced raw satellite data. The reduction of data by sampling is an essential step in the flow. By the time the ISCCP data reaches the Global Processing Center at Goddard Institute for Space Studies (GISS), the volume has been reduced by a factor of 1000. The Pilot Climate Data System (PLDS) will provide access to the ISCCP data set. It should prove to be one of the cleanest satellite data sets because it will have been through three filters--that of the operational agency, the Global Processing Center, and the PCDS. The ISCCP data set also includes other correlative data sets delivered in compatible format. Author

N86-29288*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE FIRE PROJECT c47
David McDougal *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 11 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

The International Satellite Cloud Climatology Project's (ISCCP) First ISCCP Regional Experiment (FIRE) project is a program to validate the cloud parameters derived by the ISCCP. The 4- to 5-year program will concentrate on clouds in the continental United States, particularly cirrus and marine stratocumulus clouds. As part of the validation process, FIRE will acquire satellite, aircraft, balloon, and surface data. These data (except for the satellite data) will be amalgamated into one common data set. Plans are to generate a standardized format structure for use in the PCDS. Data collection will begin in April 1986, but will not be available to the general scientific community until 1987 or 1988. Additional pertinent data sets already reside in the PCDS. Other qualifications of the PCDS for use in this validation program were enumerated. Author

N86-29289*# Iowa State Univ. of Science and Technology, Ames. Dept. of Meteorology.
USING PCDS TO STUDY THE INFLUENCE OF UV FLUX VARIATION ON THE MIDDLE ATMOSPHERE c47
Warren Heilman *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 12 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

The value of the Pilot Climate Data System (PCDS) in examining the influences of short-period solar flux variations on the middle atmosphere was demonstrated. Several Nimbus satellite data sets proposed for the study exist in the PCDS. Planned for retrieval through the PCDS are ozone mixing ratios and cumulative ozone profiles available from the Backscatter Ultraviolet Spectrophotometer on Nimbus-4. Also to be accessed are Nimbus-7 data sets that will provide ozone and nitrogen dioxide mixing ratios, temperature profiles from the Limb Infrared Monitor of the Stratosphere, and ozone mixing ratio profiles from the Solar Backscatter Ultraviolet Spectrophotometer. Bypassing the time-consuming process of reading raw data tapes, the researchers plan to transfer the PCDS processed data to an IBM PC at Iowa State University. The IBM PC will serve as an intermediate vehicle for transferring the data to the NOAA CYBER 840 at Boulder, Colorado, where research will continue on both an eight-layer radiative-photochemical numerical model and on a nonlinear dynamical model. In this research are the FGGE and ERB data sets. These relevant data sets also reside in the PCDS. Problems associated with remote access to the PCDS were discussed in regard to all the PCDS data sets. Author

N86-29290*# Michigan Univ., Ann Arbor.
PCDS AS A TOOL IN TEACHING AND RESEARCH AT THE UNIVERSITY OF MICHIGAN c47
Vincent Abreu *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 3 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

The Space Physics Research Laboratory's (SPRL) use of the Pilot Climate Data System (PCDS) is discussed. For this purpose, a computer center was established to provide the hardware and software necessary to fully utilize existing data bases for research and teaching purposes. A schematic of the SPRL network is given. The core of the system consists of two VAX 11/750s and a VAX 8600, networked through ETHERNET to several LSI 11/23 microprocessors. Much of the system is used for external communications with major networks and data centers. A VAX 11/750 provides DECNET services through the SPAN network to the PCDS. A functional diagram of PCDS usage is given. The browsing capabilities of the PCDS are used to generate data files, which are later transferred to the SPRL center for further data manipulation and display. This mode of operation for classroom instruction will be used to effectively use terminals and to simplify usage of the data base. The Atmosphere Explorer data base has been used successfully in a similar manner in courses related to the thermosphere and ionosphere. The main motivation to access the PCDS was to complement research efforts related to the High Resolution Doppler Imager (HRDI), to be flown on the Upper Atmosphere Research Satellite (UARS). Author

N86-29291*# National Oceanic and Atmospheric Administration, Washington, D. C. National Environmental Satellite Data and

Informat.

PLANNING FOR THE UTILIZATION OF THE PCDS IN STUDYING THE INTERACTION OF CLOUDS (ISCCP-C DATA) AND THE EARTH RADIATION BUDGET (ERBE DATA) **c47**

Herbert Jacobowitz *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 7 p (For primary document see N86-29282 20-42)

Avail: NTIS HC A12/MF A01 CSCL 04B

The Pilot Climate Data System (PCDS) affords an opportunity to analyze data from different but highly complementary data sets. Two of these highly complementary data sets supported by the PCDS are the International Satellite Cloud Climatology Project (ISCCP) and the Earth Radiation Budget Experiment (ERBE). Both data set sponsors are aware of the utility of one data set to the other, and both projects utilize gridded data on a 2.5 deg by 2.5 deg grid. The ISCCP data have been collected since July 1983, and the NOAA-9 data for ERBE have been collected for more than a year. Therefore, there is a good chance to use these temporally overlapping data sets to investigate hypothesized relationships. Changes in cloudiness affect both cloud albedo feedback (shortwave) and the greenhouse effect (longwave). The relative importance of the effects of clouds on albedo versus outgoing longwave radiation (OLR) in determining the radiation balance has long been a matter of controversy. Now, however, changes in cloud amount as observed by the ISCCPO can be correlated to corresponding changes in the albedo and changes in the OLR from ERBE. Monthly means can be utilized in all instances. Author

N86-29292*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

UV ALBEDO OF CLOUDS FROM TOMS DATA **c47**

David Short *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 8 p (For primary document see N86-29282 20-42)

Avail: NTIS HC A12/MF A01 CSCL 04B

The Pilot Climate Data System (PCDS) was found to be useful in examining a subset of data from the Nimbus-7 Total Ozone Mapping Spectrometer (TOMS). The TOMS instrument scans with six channels between .3 and .4 micrometers. It was suggested that by analyzing albedo values from the longer wavelength channels of the TOMS, the effects of increasing optical depth could be determined. It is spectral relationship of albedo-to-optical depth that is investigated here. The question can be stated: Is there spectral differentiation in albedo with changes in the optical depth of clouds? Nimbus-7 TOMS data were obtained through the PCDS for an area and time period for which correlative NOAA AVHRR data were available. The AVHRR data were important in determining the existing cloud patterns. As expected, no spectral differentiation was observed at very high albedos (associated with high optical depths). However, at lower optical depths, evidence of spectral dependence on albedo was observed. Mapping the results geographically was deemed highly desirable but was not possible through the PCDS at the time. The PCDS can be viewed as an effective research tool to access selected portions of data. Without being intimately familiar with a data set, a PCDS user can successfully manipulate data in a scientific study. Author

N86-29293*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ANALYSIS OF RAINFALL OVER NORTHERN PERU DURING EL NINO: A PCDS APPLICATION **c47**

Richard Goldberg and Gilberto Tisnado (Instituto Nacional de Investigacion de Transportes (Peru).) *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 23 p (For primary document see N86-29282 20-42)

Avail: NTIS HC A12/MF A01 CSCL 04B

In an examination of GOES satellite data during the 1982 through 1983 El Nino period, the appearance of lee wave cloud patterns was revealed. A correlation was hypothesized relating an anomalous easterly flow across the Andes with the appearance of these wave patterns and with the subsequent onset of intense rainfall. The cloud patterns are belived to be associated with the El Nino period and could be viewed as precursors to significant changes in weather patterns. The ultimate goal of the researchers will be the ability to predict occurrences of rainstorms associated with the appearance of lee waves and related cloud patterns as harbingers of destruction caused by flooding, huaycos, and other catastrophic consequences of heavy and abnormal rainfall. Rainfall data from about 70 stations in northern Peru from 1980 through 1984 were formatted to be utilized within the Pilot Climate Data System (PCDS). This time period includes the 1982 through 1983 El Nino period. As an example of the approach, a well-pronounced lee wave pattern was shown from a GOES satellite image of April 4, 1983. The ground truth data were then displayed via the PCDS to graphically demonstrate the increase in intensity and areal distribution of rainfall in the northern Peruvian area in the next 4 to 5 days. Author

N86-29294*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

CENTRAL ON-LINE DATA DIRECTORY **c82**

James Thieman *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 3 p (For primary document see N86-29282 20-42)

Avail: NTIS HC A12/MF A01 CSCL 04B

The National Space Science Data Center (NSSDC) Central On-Line Data Directory (CODD), which allows the general scientist remote access to information about data sets available not only at NSSDC, but throughout the scientific community, is discussed. A user may search for data set information within CODD by specifying spacecraft name, experiment name, investigator name, and/or keywords. CODD will include information on atmospheric science data sets contained not only within the PCDS, but also within other data sets that are deemed important. Keywords to be used in locating these data sets are currently being formulated. The main type of keyword to be used for categorization of data sets will be discipline related. The primary discipline keyword for PCDS-type data sets would be ATMOSPHERIC SCIENCE. A good set of subdiscipline keywords is needed under this discipline to subdivide the data sets. A sheet containing a strawman set of subdiscipline keywords was distributed, and a request was made for the knowledgeable scientists to modify or replace the proposed keywords. Author

N86-29295*# Pennsylvania State Univ., University Park. Dept. of Meteorology.

UNIVERSITY PARTICIPATION VIA UNIDATA, PART 1 **c82**

John Dutton *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 7 p (For primary document see N86-29282 20-42)

Avail: NTIS HC A12/MF A01 CSCL 04B

The UNIDATA Project is a cooperative university project, operated by the University Corporation for Atmospheric Research (UCAR) with National Science Foundation (NSF) funding, aimed at providing interactive communication and computations to the university community in the atmospheric and oceanic sciences. The initial focus has been on providing access to data for weather analysis and prediction. However, UNIDATA is in the process of expanding and possibly providing access to the Pilot Climate Data System (PCDS) through the UNIDATA system in an effort to develop prototypes for an Earth science information system. The notion of an Earth science information system evolved from discussions within NASA and several advisory committees in anticipation of receiving data from the many Earth observing instruments on the space station complex (Earth Observing System). Author

N86-29296*# University Corp. for Atmospheric Research, Boulder, Colo.

UNIVERSITY PARTICIPATION VIA UNIDATA, PART 2 **c82**

David W. Fulker *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 3 p (For primary document see N86-29282 20-42)

Avail: NTIS HC A12/MF A01 CSCL 04B

The University Corporation for Atmospheric Research (UCAR)

is presently completing UNIDATA, Phase II, considered to be the design phase of the UNIDATA Project. The four major components of the UNIDATA System are: (1) global services which access is provided, (2) long haul communication for providing that access, (3) local services for providing access and local management of acquired data, and (4) local interactive processing and graphical display. Each component is described in detail with linkages among the components elucidated. Within this framework, access to the PCDS is discussed. It is pointed out that access to the PCDS could occur via general purpose computer-to-computer communications providing remote log on to the system. The UNIDATA System could also be used to transfer information from the PCDS, provided the appropriate software is available to receive the data. Both of these scenarios require agreements on the access protocols and appropriate physical connections. Universities' needs for weather information on a near real-time basis, and UNIDATA has already established a satellite broadcast data service for this purpose.
Author

N86-29297*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NETWORK ACCESS TO PCDS (SPAN, ESN, SESNET, ARPANET) **c82**
James Green *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 29 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

One of the major goals of the National Space Science Data Center is to increase access to NASA data systems by enhancing networking activities. The activities are centered around three basic networking systems: the Space Physics Analysis Network (SPAN); the Earth Science Network (ESN); and the NASA Packet Switched System (NPSS). Each system is described, linkages among systems are explained, and future plans are announced. The inclusion of several new climate nodes on SPAN or ESN are also mentioned. Presently, the Pilot Climate Data System is accessible through SPAN and will be accessible through NPSS by summer and ESN by the end of 1986. Ambitious plans for implementation are underway. The implementation of these plans will represent a major advance in the utilization and accessibility of data worldwide.
Author

N86-29298*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
METHODS OF DOWNLOADING TO USER INSTITUTIONS **c82**
Lloyd Treinish *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 10 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

The Pilot Climate Data System (PCDS) not only supports the ability to output data in a uniform structure via the Common Data Format (CDF, but also supports the ability to provide data in native format for any data set supported by the PCDS. Methods are discussed for acquiring data in either format from the PCDS for further work at remote sites. Four levels of remote utilization are defined, based on the extent of offloading the National Space Science Data Center (NSSDC) computer and local PCDS processing. Characteristics of each level are thoroughly explained, including details of information and data transfers, downloading, uploading, and offloading of the NSSDC computer. Only the levels themselves are specified here. The first level defined is that of a network-based distributed PCDS. A subset of the PCDS software is ported to another VAX and made available on a network (i.e., SPAN) node. There is no subset of the PCDS at the second level, but it is also network based. Non-network utilization of the PCDS, requiring dial-up log on, is denoted as a third level. Finally, at the fourth level, personal computer utilization of the PCDS through dial-up log on with proper terminal emulation is defined.
Author

N86-29299*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OPTICAL DISKS **c35**
Brian Lopez-Swafford *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 9 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

A comprehensive overview of the different types of optical storage technology is presented. Research efforts to integrate this technology into the VAX/VMS environment are discussed. In addition, plans for future applications of optical disk technology are described. The applications should prove to be beneficial to the NSSDC user community as a whole. Of particular interest is the concentration on the collaboration with the Dynamics Explorer project.
Author

N86-29300*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE CDF SOFTWARE PACKAGE **c61**
C. Edwin Wilson *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 11 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

The concepts that are fundamental to the new Common Data Format are outlined. With Pilot Climate Data System (PCDS) Version 4.0, the Common Data Format (CDF) will supersede the Climate Data File (also CDF) or earlier versions. This new format incorporates generalizations in both design and terminology that make it applicable to multidisciplinary data sets. Furthermore, the new CDF will be made available to programmers as a software package that shields them from the low-level details of file formats. The CDF interface routines create an abstract conceptual environment for the scientific programmer. The principle concept for visualizing a CDF is known as the basic grid. A basic grid is an n-dimensional block by means of which a CDF is constructed. The size of the block may vary from one CDF to another, but is consistent within any individual CDF. Thus, the basic grid serves as a fundamental uniform building block for a CDF. The number of grid dimensions and the size of each dimension are chosen by the scientist/programmer to represent the patterns by which data are structured. The uniform grid structure appears to the programmer to be propagated into each record for each variable. The CDF stores a variable value for each lattice point of the grid for each record. These data values are inserted and retrieved simply by specifying the variable's identifier, a record number, and the indices that specify the lattice point of interest.
Author

N86-29301*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THERMOSPHERE DYNAMICS WORKSHOP, VOLUME 2
Hans G. Mayr, ed. and Nathan J. Miller, ed. Jun. 1986 461 p Workshop held in Beltsville and Calverton, Md., 3-5 Oct. 1984 Original contains color illustrations
(NASA-CP-2389; Rept-85B0268; NAS 1.55:2389) Avail: NTIS HC A20/MF A01 CSCL 04A

Atmospheric observations reported on include recent measurements of thermospherical composition, gas temperatures, auroral emissions, ion-neutral collisional coupling, electric fields, and plasma convection. Theoretical studies reported on include model calculations of thermospherical general circulation, thermospheric tides, thermospheric tidal coupling to the lower atmosphere, interactions between thermospheic chemistry and dynamics and thermosphere-ionosphere coupling processes. The abstracts provide details given in each talk but the figures represent the fundamental information exchanged within the workshop For individual titles, see N86-29302 through N86-29338.

N86-29302*# National Center for Atmospheric Research, Boulder, Colo.
APPLICATIONS OF A VENUS THERMOSPHERIC CIRCULATION MODEL **c91**
S. W. Bougher, R. E. Dickinson, E. C. Ridley, and R. G. Roble *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 1-21 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 03B

A variety of Pioneer Venus observations suggest a global scale, day-to-night Venus thermospheric circulation. Model studies of the dynamics and energetics of the Venus thermosphere are presented in order to address new driving, mixing and cooling mechanisms for an improved model simulation. The adopted approach was to reexamine the circulation by first using a previous two dimensional code to quantify those physical processes which can be inferred from the Pioneer Venus observations. Specifically, the model was used to perform sensitivity studies to determine the degree to which eddy cooling, eddy or wave drag, eddy diffusion and 15 micrometer radiational cooling are necessary to bring the model temperature and composition fields into agreement with observations. Three EUV heating cases were isolated for study. Global temperature and composition fields in good agreement with Pioneer data were obtained. Large scale horizontal winds < 220 m/s were found to be consistent with the observed cold nightside temperatures and dayside bulges of O, CO and CO2. Observed dayside temperatures were obtained by using a 7 to 19% EUV heating efficiency profile. The enhanced 15 micrometer cooling needed for thermal balance is obtained using the best rate coefficient available for atomic O collisional excitation of CO2(0, 1,0). Eddy conduction was not found to be a viable cooling mechanism due to the weakened global circulation. The strong 15 micrometer damping and low EUV efficiency imply a very weak dependence of the general circulation to solar cycle variability. The NCAR terrestrial thermospheric general circulation model was adapted for Venus inputs using the above two dimensional model parameters, to give a three dimensional benchmark for future Venus modelling work. Author

N86-29303*# Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.

DYNAMICS OF THE NIGHTTIME THERMOSPHERE AT ARECIBO **c46**

R. G. Burnside, J. C. G. Walker, and C. A. Tepley (Arecibo Ionospheric Observatory, Puerto Rico.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 23-28 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

Incoherent scatter radar observations of the nighttime F layer at Arecibo, Puerto Rico, are used to determine the O+ diffusion velocity at different altitudes. Further analysis allows evaluation of the neutral wind and the ion-drag force in the direction of the magnetic meridian. The local acceleration of the meridional neutral wind is also determined. The possibility of evaluating the viscous force using incoherent scatter radar data was also investigated. Preliminary results indicate that, at certain times and at altitudes above about 350 km, viscous drag may be a significant term in the neutral equation of motion. Combining these results allows height profiles of the meridional pressure gradient to be deduced. The pressure gradients thus derived is compared with that determined from measurements of the horizontal temperature gradient and that given by the MSIS model atmosphere. Author

N86-29304*# Texas Univ. at Dallas, Richardson. Center for Space Sciences.

MEDIUM AND LARGE-SCALE VARIATIONS OF DYNAMO-INDUCED ELECTRIC FIELDS FROM AE ION DRIFT MEASUREMENTS **c46**

W. R. Coley and J. P. McClure *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 29-50 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

Current models of the low latitude electric field are largely based on data from incoherent scatter radars. These observations are extended through the addition of the rather extensive high quality electric field measurements from the Ion Drift Meter (IDM) aboard the Atmosphere Explorer (AE) spacecraft. Some preliminary results obtained from the Unified Abstract files of satellite AE-E are presented. This satellite was active from the end of 1975 through June 1981 in various elliptical and circular orbits having an inclination near 20 deg. The resulting data can be examined for the variation of ion drift with latitude, longitude, season, solar cycle, altitude, and magnetic activity. The results presented deal primarily with latitudinal variations of the drift features. Diagrams of data are given and briefly interpreted. The preliminary results presented here indicate that IDM data from the AE and the more recent Dynamics Explorer B spacecraft should continue to disclose some interesting and previously unobserved dynamical features of the low latitude F region. Author

N86-29305*# Augsburg Coll., Minneapolis, Minn. Dept. of Physics.

ATOMIC NITROGEN DENSITIES NEAR THE POLAR CUSP **c46**

M. J. Engebretson and J. T. Nelson *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 51-61 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

The neutral atmospheric composition spectrometer on board the Dynamics Explorer 2 spacecraft sampled several major and minor thermospheric gases including atomic nitrogen. A selection of passes over the polar cusp that provide a quantitative measure of N densities in this region and provide evidence of localized density increases due to soft particle precipitation is presented. Increases in N densities are frequently observed but are smaller than accompanying increases in N2 densities. The observations support earlier studies suggesting that N densities increase more rapidly than O densities during periods of high solar EUV flux and N densities are larger in the summer hemisphere than in the winter hemisphere. A series of passes in February 1983, late in the lifetime of DE 2, indicated N densities at 200 km altitude were a factor of 2 larger near the southern cusp than near the northern cusp. Author

N86-29306*# National Center for Atmospheric Research, Boulder, Colo.

SIMULATION OF THE THERMOSPHERIC TIDES BY USE OF THE NCAR THERMOSPHERIC GENERAL CIRCULATION MODEL **c46**

C. G. Fensen, R. E. Dickinson, and R. G. Roble *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 63-77 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

Numerical calculations of the thermospheric tidal winds and temperatures at equinox are presented. The calculations were made using the National Center for Atmospheric Research Thermospheric General Circulation Model (TGCM), which includes the effects of viscosity, conductivity, diffusion, ion drag, winds, and temperature gradients. The thermospheric diurnal and semidiurnal tides are excited in situ by solar heating and by ion-neutral momentum coupling. The semidiurnal tidal calculations also include the effects of upward propagating waves generated by heating in the lower atmosphere. This semidiurnal propagating component is modeled by use of the classical tidal perturbations as lower boundary conditions. The model is tuned by adjusting the propagating tidal forcing term until calculated semidiurnal wind and temperature fields best approximate incoherent scatter observations. The tidal TGCM results are consistent with previous theoretical work and successfully reproduce high altitude temperature and meridional velocity data, but they give significantly lower magnitudes for velocities and temperatures near 160 km than are seen by observations. Author

N86-29307*# Boston Univ., Mass. Dept. of Electrical, Computer and Systems Eng.

TIDAL COUPLING WITH THE LOWER ATMOSPHERE (INVITED REVIEW) **c46**

Jeffrey M. Forbes *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 79-96 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

The various ways are reviewed in which propagating tidal components excited in the mesophere and below affect the structure of the thermosphere and ionosphere above 100 km.

Dynamo effects are not treated here. The physical processes affecting the propagation of upward propagating tides are examined and how they are interrelated in the context of a numerical model. Propagating diurnal and semidiurnal tides which reach thermospheric heights are excited primarily by insolation absorption by tropospheric water vapor (0 to 5 km) and stratospheric/mesospheric ozone (40 to 60 km), respectively. Simulation of these oscillations requires consideration of mean zonal winds and meridional temperature gradients, and the damping effects of turbulent and molecular dissipation, radiative cooling, and ion drag. These effects must be considered on a spherical rotating atmosphere extending from the ground to above 300 km, as they are in the model developed by Forbes depicted schematically.
Author

N86-29308*# National Center for Atmospheric Research, Boulder, Colo.
THE EFFECT OF BREAKING GRAVITY WAVES ON THE DYNAMICS AND CHEMISTRY OF THE MESOSPHERE AND LOWER THERMOSPHERE (INVITED REVIEW) c46
Rolando R. Garcia *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 97-103 Sponsored by NSF (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

The influence of breaking gravity waves on the dynamics and chemical composition of the 60 to 110 km region is investigated with a two dimensional model that includes a parameterization of gravity wave momentum deposition and diffusion. The dynamical model is described by Garcia and Solomon (1983) and Solomon and Garcia (1983) and includes a complete chemical scheme for the mesosphere and lower thermosphere. The parameterization of Lindzen (1981) is used to calculate the momentum deposited and the turbulent diffusion produced by the gravity waves. It is found that wave momentum deposition drives a very vigorous mean meridional circulation, produces a very cold summer mesopause and reverse the zonal wind jets above about 85 km. The seasonal variation of the turbulent diffusion coefficient is consistent with the behavior of mesospheric turbulences inferred from MST radar echoes. The large degree of consistency between model results and various types of dynamical and chemical data supports very strongly the hypothesis that breaking gravity waves play a major role in determining the zonally-averaged dynamical and chemical structure of the 60 to 110 km region of the atmosphere.
Author

N86-29309*# Liege Univ. (Belgium). Inst. d'Astrophysique.
THERMOSPHERIC NITRIC OXIDE AND ITS ROLE IN THERMOSPHERIC DYNAMICS AND COMPOSITION c46
J.-Cl. Gerard and R. G. Roble (National Center for Atmospheric Research, Boulder, Colo.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 105-117 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

The global distribution of thermospheric nitric oxide has been measured under different geophysical conditions by the Atmosphere Explorer (AE) and Solar Mesosphere Explorer (SME) satellites. These observations show a great variability in the NO concentration but the existence of a latitudinal gradient is clearly evidenced by statistical maps of the NO meridional distribution. A two dimensional zonally averaged chemical-dynamical model was used to investigate the importance of nitric oxide 5.3 micrometer cooling and its role on thermospheric temperature, dynamics and major gas composition. For this purpose, a 2-D background atmosphere code and an odd nitrogen code were coupled and run to steady state. The NO distribution obtained is in good agreement with the AE-D global picture calculated at solstice for solar minimum activity. The importance of each term in the thermodynamic equation was studied spatially. It is found that the NO I.R. cooling term competes with conduction in the upper thermosphere and reaches its maximum value near 200 km at high summer latitudes. The primary effect of including the NO cooling term is to increase the temperature in the upper winter thermosphere and decrease it in the other hemisphere, if the global average temperature is fixed. In general, the strength of the circulation is decreased and the thermal gradient is smoother. As a consequence of these changes in the wind and temperature fields, the O2, N2 and O densities also react to the effect of the NO cooling. The importance of this process depends on the level of solar activity which controls the NO distribution.
Author

N86-29310*# Polytechnic Inst. of New York, Farmingdale.
GLOBAL LARGE SCALE STRUCTURES IN THE F REGION c46
S. H. Gross *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 119-135 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

Measurements of neutral densities, temperatures and ion density and temperature by the Atmosphere Explorer C and E satellites exhibit fluctuations made up of coherent waves of scale size from hundreds to thousands of kilometers. The fluctuations in the AE-C data are found at times of low magnetic activity to extend from the auroral region in one hemisphere across the equator to the corresponding region in the other hemisphere with little change in apparent wavelength. The fluctuations in the AE-E data similarly exhibit at times of low magnetic activity nearly uniform wave structure encircling the equatorial belt. Typical examples of waves of more than 1000 km apparent wavelength in both the AE-C and AE-E data are presented. These observations during quiet times may be explained by a system of quasi-stationary waves excited by the auroral belts that are distributed about the Earth possibly with tidal or sub-tidal periods and scale lengths determined by the structure of the belts. According to this interpretation, Traveling Ionospheric Disturbance (TID's) are manifestations of transient wave systems moving past a ground observatory that result from changes in magnetic activity with periods and scale sizes associated with the regions of enhanced auroral activity. Some evidence suggesting tidal-like stationary waves from the Millstone Hill incoherent scatter radar is presented.
Author

N86-29311*# Texas Univ. at Dallas, Richardson. Center for Space Sciences.
THE MEASURED MOTIONS INSIDE EQUATORIAL PLASMA BUBBLES c46
W. B. Hanson and D. K. Bamgboye (Ilorin Univ., Nigeria) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 137-151 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

A preliminary study of the vertical and north-south horizontal ion motions in plasma bubbles in the near-equatorial ionosphere utilizing drift meter data from Atmosphere Explorer E is presented. High resolution data show that the vertical ion velocity in some bubbles increase approximately linearly with (N(0)-N)N, where N(0) is the background ion concentration and N is the bubble ion concentration. At sufficiently large N(0)/N the vertical ion velocity saturates, but often at a value substantially larger than the ratio of the gravitational acceleration to the ion neutral collision frequency. These larger than nominal velocities may result from background eastward electric fields and/or from a vertically elongated bubble cross section. The unanticipated observations that large poleward horizontal drifts accompany these vertical drifts seems to follow naturally from a redistribution of plasma along flux tubes as the plasma convects from the bottomside of the F region to high altitudes.
Author

N86-29312*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UT/LONGITUDINAL VARIATIONS OF COMPOSITION IN DE DATA c46
A. E. Hedlin *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 153-162 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

Composition data obtained by the quadrupole mass spectrome-

ter (NACS) carried aboard the DE-B satellite were examined for variations in the polar regions during magnetically quiet conditions. The corresponding predictions of the MSIS-83 model are often used for comparison. The MSIS-83 model is used to emphasize the variations of interest by suppressing all other variations. A persistent enhancement of N2 density and a depletion of He density are present in the vicinity of the magnetic poles with maximum density response in the morning hours (magnetic) on average. A universal time (UT) variation in average density levels is evident near both the geographic and magnetic poles. There are systematic morphology changes with UT and between summer and winter which are qualitatively consistent with the simple concept that thermospheric heating effects are shifted or spread in the downwind direction of the global circulation systems driven by EUV and magnetospheric sources. The magnitude of the UT variations is larger in the southern hemisphere and is larger in local winter than summer. Author

N86-29313*# Texas Univ. at Dallas, Richardson. Center for Space Science.

CONVECTION PATTERN MORPHOLOGY AND VARIATIONS (INVITED REVIEW) **c46**

R. A. Heelis *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 163-178 (For primary document see N86-29301 20-42)

Avail: NTIS HC A20/MF A01 CSCL 04A

A fairly straightforward consideration of the interaction between a southward interplanetary magnetic field and the Earth's magnetic field will result in the prediction of a two cell convection pattern in the high latitude ionosphere. This is shown schematically where the antisunward flow at high latitudes results from the application of the solar wind electric field to the ionosphere and the return sunward flow results from an electric field generated in the plasma sheet to ensure continuity. This convection pattern can be quite easily characterized in terms of the radius of the approximately circular region containing the antisunward flow, called the polar cap and the maximum potential difference applied across this region. The convection pattern described is at least understandable in terms of solar wind/magnetosphere interaction in which open field lines are recirculated in the polar cap and a viscous interaction process exists near the flanks of the magnetosphere's equatorial plane giving rise to the lower latitude convection cells. Author

N86-29314*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

INTERACTION OF THE EQUATORIAL MIDNIGHT PRESSURE BULGE AND THERMOSPHERIC ZONAL WINDS **c46**

F. A. Herrero *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 179-184 (For primary document see N86-29301 20-42)

Avail: NTIS HC A20/MF A01 CSCL 04A

The zonal component of the thermospheric neutral wind in the equatorial region is found to flow eastward all night, having a minimum near midnight. The data, obtained by Spencer et al. on the Dynamics Explorer-2 (DE-2) satellite, and reported more recently by Wharton et al., indicate that the minimum feature is significant. The minimum is illustrated by a 4th order Fourier series fit to the data points reported by Wharton et al. A table gives the amplitudes and phases of the four harmonic components used with the estimated error for each amplitude. It is asked whether this behavior is due to the local passage of the equatorial midnight pressure bulge associated with the midnight temperature anomaly. If so, it is to be expected that other data characterizing the midnight temperature anomaly should show consistency with this observation, especially in view of the large changes observed in the zonal velocity in the midnight sector. Consistency in momentum conservation may be checked using available data from previous independent experiments. Such data, taken under similar conditions of solar activity, was substituted into the momentum equation and found to be consistent using a priori estimates of the effect of viscosity. Author

N86-29315*# Michigan Univ., Ann Arbor. Space Physics Research Lab.

ION NEUTRAL COUPLING IN THE HIGH LATITUDE THERMOSPHERE, PART 1 **c46**

T. L. Killeen *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 185-187 (For primary document see N86-29301 20-42)

Avail: NTIS HC A20/MF A01 CSCL 04A

Measurements of the neutral wind in the polar F region from Dynamics Explorer-2 (DE-2) were used to illustrate asymmetries in the neutral circulation that are dependent on the sign of the B sub y component of the interplanetary magnetic field (IMF). Individual DE-2 orbits and averaged data sets from different Universal times are presented. The data are categorized according to the sign of the hourly averaged IMF B sub y component measured by ISEE-3 for the hour preceding the DE-2 measurement. The major features observed are: (1) an asymmetry in the polar cap neutral flow velocity with the region of most rapid antisunward flow shifting from the dawn side to the dusk side of the polar cap as B sub y changes from positive to negative; (2) a shift in magnetic local time of the region of entry of neutral gas into the polar cap from a location on the dawn side of the noon-midnight meridian for B sub y positive to one more biased towards the dusk side for B sub y negative; (3) an enhancement in the velocities associated with the dawn, anti-clockwise neutral vortex B suby y negative relative to those observed for B sub y positive. The B sub y neutral wind asymmetries can be explained by similar asymmetries, previously observed, in the polar ion convection pattern. They imply a direct causal relationship between solar wind/magnetosphere coupling and neutral thermospheric dynamics. Author

N86-29316*# Michigan Univ., Ann Arbor. Space Physics Research Lab.

ION-NEUTRAL COUPLING IN THE HIGH LATITUDE THERMOSPHERE, PART 2 **c46**

T. L. Killeen *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 189-193 (For primary document see N86-29301 20-42)

Avail: NTIS HC A20/MF A01 CSCL 04A

On the 24th November, 1982, The North-South (Bz) component of the Interplanetary Magnetic Field (IMF) became positive for a period of about 11 hours reaching a relatively large and steady value of approximately 25 nT. During this rare occurrence, the Dynamics Explorer-2 (DE-2) spacecraft was in a configuration that enabled the dynamics of both ionic and neutral species of the high latitude F region to be measured simultaneously along the track of the polar orbiting satellite. Results from two Northern (winter) polar passes of DE-2, extracted from a larger data set, are shown to illustrate the response of the neutral F region to ion drag forcing arising from a configuration of ion convection characteristics of strongly northward IMF. The measured neutral winds differ appreciably from those more commonly observed for periods of southward IMF. The multi-cellular ion drift pattern associated with positive Bz is observed to drive a similar but less structured and weaker neutral wind configuration in the winter polar cap. Major features of the ion drift pattern are mimicked by the neutral circulation but smaller scale and more irregular sturctures of ion flow are not. This is ascribed to the relatively long time constant (few hours) for momentum exchange between the ion and neutral gases. The results demonstrate that sunward flow of neutral gas can be established and maintained by ion drag in the central polar cap for positive Bz. Author

N86-29317*# Clemson Univ., S.C. Dept. of Physics and Astronomy.

GEOSTROPHIC ADJUSTMENT IN A SHALLOW-WATER NUMERICAL MODEL AS IT RELATES TO THERMOSPHERIC DYNAMICS **c46**

M. F. Larsen and I. S. Mikkelsen (Danish Meteorological Inst., Copenhagen.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 195-204 (For primary document see N86-29301 20-42)

Avail: NTIS HC A20/MF A01 CSCL 04A

The theory of geostrophic adjustment and its applications to the dynamics of the high latitude thermosphere have been discussed in previous papers based on a linearized treatment of the fluid dynamical equations. However, a linearized treatment is only valid for small Rossby numbers given by Ro = V/fL, where V is the wind speed, f is the local value of the Coriolis parameter, and L is a characteristic horizontal scale for the flow. For typical values in the auroral zone, the approximation is not reasonable for wind speeds greater than 25 m/s or so. A shallow-water (one layer) model was developed that includes the spherical geometry and full nonlinear dynamics in the momentum equations in order to isolate the effects of the nonlinearities on the adjustment process. A belt of accelerated winds between 60 deg and 70 deg latitude was used as the initial condition. The adjustment process was found to proceed as expected from the linear formulation, but that an asymmetry between the response for an eastward and westward flow results from the nonlinear curvature (centrifugal) terms. In general, the amplitude of an eastward flowing wind will be less after adjustment than a westward wind. For instance, if the initial wind velocity is 300 m/s, the linearized theory predicts a final wind speed of 240 m/s, regardless of the flow direction. However, the nonlinear curvature terms modify the response and produce a final wind speed of only 200 m/s for an initial eastward wind and a final wind speed of almost 300 m/s for an initial westward flow direction. Also, less gravity wave energy is produced by the adjustment of the westward flow than by the adjustment of the eastward flow. The implications are that the response of the thermosphere should be significantly different on the dawn and dusk sides of the auroral oval. Larger flow velocities would be expected on the dusk side since the plasma will accelerate the flow in a westward direction in that sector. Author

N86-29318*# Air Force Geophysics Lab., Hanscom AFB, Mass.
SATELLITE ACCELEROMETER MEASUREMENTS OF NEUTRAL DENSITY AND WINDS DURING GEOMAGNETIC STORMS c46
Frank A. Marcos and Jeffrey M. Forbes (Boston Univ., Mass.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 205-219 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

A new thermospheric wind measurement technique is reported which is based on a Satellite Electrostatic Triaxial Accelerometer (SETA) system capable of accurately measuring accelerations in the satellite's in-track, cross-track and radial directions. Data obtained during two time periods are presented. The first data set describes cross-track winds measured between 170 and 210 km during a 5-day period (25 to 29 March 1979) of mostly high geomagnetic activity. In the second data set, cross-track winds and neutral densities from SETA and exospheric temperatures from the Millstone Hill incoherent scatter radar are examined during an isolated magnetic substorm occurring on 21 March 1979. A polar thermospheric wind circulation consisting of a two cell horizontal convection pattern is reflected in both sets of cross-track acceleration measurements. The density response is highly asymmetric with respect to its day/night behavior. Latitude structures of the density response at successive times following the substorm peak suggest the equatorward propagation of a disturbance with a phase speed between 300 and 600 m/s. A deep depression in the density at high latitudes (less than 70 deg) is evident in conjunction with this phenomenon. The more efficient propagation of the disturbance to lower latitudes during the night is probably due to the midnight surge effect. Author

N86-29319*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRANSFER FUNCTION ANALYSIS OF THERMOSPHERIC PERTURBATIONS c46
H. G. Mayr, I. Harris, F. Varosi (Science Applications Research, Riverdale, Md.), F. A. Herrero, and N. W. Spencer *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 221-231 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

Applying perturbation theory, a spectral model in terms of vectors spherical harmonics (Legendre polynomials) is used to describe the short term thermospheric perturbations originating in the auroral regions. The source may be Joule heating, particle precipitation or ExB ion drift-momentum coupling. A multiconstituent atmosphere is considered, allowing for the collisional momentum exchange between species including Ar, O2, N2, O, He and H. The coupled equations of energy, mass and momentum conservation are solved simultaneously for the major species N2 and O. Applying homogeneous boundary conditions, the integration is carred out from the Earth's surface up to 700 km. In the analysis, the spherical harmonics are treated as eigenfunctions, assuming that the Earth's rotation (and prevailing circulation) do not significantly affect perturbations with periods which are typically much less than one day. Under these simplifying assumptions, and given a particular source distribution in the vertical, a two dimensional transfer function is constructed to describe the three dimensional response of the atmosphere. In the order of increasing horizontal wave numbers (order of polynomials), this transfer function reveals five components. To compile the transfer function, the numerical computations are very time consuming (about 100 hours on a VAX for one particular vertical source distribution). However, given the transfer function, the atmospheric response in space and time (using Fourier integral representation) can be constructed with a few seconds of a central processing unit. This model is applied in a case study of wind and temperature measurements on the Dynamics Explorer B, which show features characteristic of a ringlike excitation source in the auroral oval. The data can be interpreted as gravity waves which are focused (and amplified) in the polar region and then are reflected to propagate toward lower latitudes. Author

N86-29320*# Michigan Univ., Ann Arbor. Space Physics Research Lab.
EQUATORIAL THERMOSPHERIC MEASUREMENTS OF TEMPERATURES AND WINDS AT AREQUIPA, PERU c46
John W. Meriwether, Jr. and Manfred A. Biondi (Pittsburgh Univ., Pa.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 233-251 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

Enhancement of FPI temperatures above quiet levels was observed a few hours after the start of magnetic activity. Magnitude of this enhancement is about 300 degrees. This is followed by relaxation to prestorm levels. Apparent average offset of RPI temperatures from mass spectrometer incoherent scatter radar by 100 to 200 degrees for relatively quiet times is also observed. There was a definite suggestion of a midnight thermal enhancement for April and August data, with a magnitude of about 100 degrees, seen in both 1983 and 1984 observations. There was a definite enhancement of 6300A surface brightness in the south as compared with other directions, probably connected to the tropical airglow arcs. Meridional winds were small (less than 25 m/s) throughout night. Indication of northward migration of the observed 6300A enhancement in the evening hours as observations approach local winter solstice. This is probably related to the observed poleward (to the south) meridional wind (of magnitude 50 m/s) in this period. Zonal component of winds always eastward, but speed approaches zero sooner near equinox than at summer solstice. Typical magnitude at peak is of order 100 to 150 m/s. Suggestion of zonal wind increase after twilight and recovery of 6300A emission for April data. Origin not clear but may be related to midnight thermal enhancement. Meridional wind virtually zero for equinox in 1983; shows evening flow towards winter hemisphere in early evening for solstice data. Suggestion of post-midnight surge in April 1984 data. No major effects associated with magnetic storm activity, but a suggestion of decrease in zonal component below nominal levels. Author

N86-29321*# Michigan Univ., Ann Arbor. Space Physics Research Lab.
POLAR CAP OBSERVATIONS OF THERMOSPHERIC WINDS AND TEMPERATURES AT SONDRE STROMFJORD, GREEN-

LAND c46

John W. Meriwether, Jr. and P. Shih *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 253-261 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

An agreement of averaged temperatures with mass spectrometer incoherent scatter radar looked reasonable for several nights, but for many nights there are differences: (1) midnight period of cooling, and (2) temperature increases associated with overhead crossings of the auroral belt. The observed rise of the temperature before dawn in conjunction with the high 6300A intensities suggests a connection between the two effects: soft particle precipitation most likely candidate but frictional heating perhaps also a possibility. A comparison with the thermospheric general circulation model calculations also needed. The technique for formulating neutral wind vectors performs well in most cases. The observed patterns show evidence for abatement in the midnight sector in the meridional wind component at the separatix between the two cells with a frequency of the order of 20 to 25%, also observed in radar observations at Sondre Stromfjord. The observed patterns for magnetically quiet conditions show flow characteristic of the auroral belt, westward in evening followed by the midnight surge. The observed patterns for active conditions show dominance either by the evening cell or the morning cell, but most often the former. Author

N86-29322*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

ZONAL WIND OBSERVATIONS DURING A GEOMAGNETIC STORM c46

N. J. Miller and N. W. Spencer *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 263-267 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

In situ measurements taken by the Wind and Temperature Spectrometer (WATS) onboard the Dynamics Explorer 2 spacecraft during a geomagnetic storm display zonal wind velocities that are reduced in the corotational direction as the storm intensifies. The data were taken within the altitudes 275 to 475 km in the dusk local time sector equatorward of the auroral region. Characteristic variations in the value of the Dst index of horizontal geomagnetic field strength are used to monitor the storm evolution. The detected global rise in atmospheric gas temperature indicates the development of thermospheric heating. Concurrent with that heating, reductions in corotational wind velocities were measured equatorward of the auroral region. Just after the sudden commencement, while thermospheric heating is intense in both hemispheres, eastward wind velocities in the northern hemisphere show reductions ranging from 500 m/s over high latitudes to 30 m/s over the geomagnetic equator. After 10 hours storm time, while northern thermospheric heating is diminishing, wind velocity reductions, distinct from those initially observed, begin to develop over southern latitudes. In the latter case, velocity reductions range from 300 m/s over the highest southern latitudes to 150 m/s over the geomagnetic equator and extend into the Northern Hemisphere. The observations highlight the interhemispheric asymmetry in the development of storm effects detected as enhanced gas temperatures and reduced eastward wind velocities. Zonal wind reductions over high latitudes can be attributed to the storm induced equatorward spread of westward polar cap plasma convection and the resulting plasma-neutral collisions. However, those collisions are less significant over low latitudes; so zonal wind reductions over low latitudes must be attributed to an equatorward extension of a thermospheric circulation pattern disrupted by high latitude collisions between neutrals transported via eastward winds and ions convecting westward. Author

N86-29323*# State Univ. of New York, Albany. Dept. of Atmospheric Science.

MEASUREMENTS OF THERMOSPHERIC RESPONSE TO AURORAL ACTIVITIES c46

S. Okano (Tohoku Univ., Sendai, Japan) and J. S. Kim *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 269-274 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

The Joule heating produced by auroral electrojets and its thermospheric response can be studied by monitoring the thermospheric temperatures by optical methods; simultaneously, the concurrent auroral electrojet activities can be investigated by using geomagnetic records obtained from stations along a meridian close to the observation site of optical measurements. The measurements are reported of thermospheric response to auroral activities which were made at Albany (42.68 deg N, 73.82 deg W), New York on September 2, 1978 (UT) when an isolated substorm occured. The thermospheric temperatures were measured by using a high resolution Fabry-Perot interferometer that determines the line profiles of the (OI) 6300A line emission. The intensities and latitudinal positions of auroral electrojets were obtained by the analysis of magnetograms from the IMS Fort Churchill meridian chain stations. Author

N86-29324*# Massachusetts Inst. of Tech., Cambridge. Haystack Observatory.

INITIAL RESULTS OF THE GLOBAL THERMOSPHERIC MAPPING STUDY (GTMS) c46

W. L. Oliver, J. E. Salah, R. G. Musgrove, J. M. Holt, V. B. Wickwar (SRI International Corp., Menlo Park, Calif.), G. J. Hernandez (National Oceanic and Atmospheric Administration, Boulder, Colo.), and R. G. Roble (National Center for Atmospheric Research, Boulder, Colo.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 275-296 Original contains color illustrations (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

The Global Thermospheric Mapping Study (GTMS) is a multi-technique experimental study of the thermosphere designed to map simultaneously its spatial and temporal morphology with a thoroughness and diversity of measurement techniques heretofore unachieved. The GTMS is designed around the Incoherent Scatter Radar Chain in the western hemisphere. The European incoherent scatter radars and the worldwide communities of Fabry-Perot interferometers, meteor wind radars, partial reflection drifts radars, MST radars, and satellite probes are included to extend the spatial coverage and types of measurements available. Theoretical and modeling support in the areas of thermospheric and ionospheric structure, tides, and electric fields are included to aid in program planning and data interpretation. Solar activity was low on the three observation days (F10.7 = 97, 98, 96) and magnetic conditions were unsettled to active (A = 10, 12, 20). All six incoherent scatter radar facilities collected data. Each collected F region data day and night while Saint Santin and Millstone Hill additionally collected E region data during daylight hours. Initial results from Sondrestrom and Millstone Hill are presented. Good quality Fabry Perot data were collected at Fritz Peak and San Jose dos Campos. Weather conditions produced poor results at Arequipa and Arecibo. Initial results from Fritz Peak are presented. Mesosphere/lower-thermosphere observations were conducted under the ATMAP organization. The magnetometer chains also were operational during this campaign. Initial thermospheric general circulation model predictions were made for assumed solar-geophysical conditions, and selected results are presented. Author

N86-29325*# University Coll., London (England). Dept. of Physics and Astronomy.

OBSERVATIONS OF VERTICAL WINDS AND THE ORIGIN OF THERMOSPHERIC GRAVITY WAVES LAUNCHED BY AURORAL SUBSTORMS AND WESTWARD TRAVELLING SURGES c46

David Rees *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 297-322 Original contains color illustrations (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

Several sequences of observations of strong vertical winds in the upper thermosphere are discussed, in conjunction with models

of the generation of such winds. In the auroral oval, the strongest upward winds are observed in or close to regions of intense auroral precipitation and strong ionospheric currents. The strongest winds, of the order of 100 to 200 m/sec are usually upward, and are both localized and of relatively short duration (10 to 20 min). In regions adjacent to those displaying strong upward winds, and following periods of upward winds, downward winds of rather lower magnitude (40 to about 80 m/sec) may be observed. Strong and rapid changes of horizontal winds are correlated with these rapid vertical wind variations. Considered from a large scale viewpoint, this class of strongly time dependent winds propagate globally, and may be considered to be gravity waves launched from an auroral source. During periods of very disturbed geomagnetic activity, there may be regions within and close to the auroral oval where systematic vertical winds of the order of 50 m/sec will occur for periods of several hours. Such persistent winds are part of a very strong large scale horizontal wind circulation set up in the polar regions during a major geomagnetic disturbance. This second class of strong horizontal and vertical winds corresponds more to a standing wave than to a gravity wave, and it is not as effective as the first class in generating large scale propagating gravity waves and correlated horizontal and vertical oscillations. A third class of significant (10 to 30 m/sec) vertical winds can be associated with systematic features of the average geomagnetic energy and momentum input to the polar thermosphere, and appear in statistical studies of the average vertical wind as a function of Universal Time at a given location. Author

N86-29326*# University Coll., London (England). Dept. of Physics and Astronomy.

THE TIME-DEPENDENT DYNAMICAL RESPONSE OF THE THERMOSPHERE TO MAJOR GEOMAGNETIC DISTURBANCES **c46**

David Rees *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 323-339 Original contains color illustrations (For primary document see N86-29301 20-42)

Avail: NTIS HC A20/MF A01 CSCL 04A

Several recent observations of thermospheric dynamics made in the polar regions during extremely disturbed geomagnetic periods are reviewed. In general, the magnitude and the variability of winds in the thermospheric polar regions increases with magnetic activity, as measured by any of the conventional indices. However, none of the conventional indices is a particularly good aid to predicting wind magnitudes. In very general terms, two major factors may be considered in describing the wind system. The magnitude of the Interplanetary Magnetic Field (IMF) and, in particular, its southward component, determine the size of the auroral oval, and the strength of the cross-polar cap potential. This determines the size of the auroral oval, the magnitude of the sunward winds in the auroral oval and of those blowing anti-sunward over the polar cap, and is probably the major factor in determining the rate of geomagnetic energy deposition in the thermosphere. Superimposed on this enhanced polar circulation system are the effects of discrete auroral substorms. From a global view point, the effect of substorms is to generate a series of strong disturbances which propagate from their source region, usually near magnetic midnight in the auroral oval. The energy associated with discrete substorms is, however, usually a rather small proportion of the total global geomagnetic input during disturbed periods. These observations of thermospheric wind disturbances will be evaluated by comparison with global simulations of the thermospheric response to theoretical and semi-empirical models of the polar electric field, and of the effects of magnetospheric particle precipitation. Author

N86-29327*# University Coll., London (England). Dept. of Physics and Astronomy.

SELF-CONSISTENT MODELLING OF THE POLAR THERMOSPHERE AND IONOSPHERE TO MAGNETOSPHERIC CONVECTION AND PRECIPITATION (INVITED REVIEW) **c46**

David Rees, Tim Fuller-Rowell, Shaun Quegan (Marconi Space and Defence Systems Ltd., Chelmsford England), and Roy Moffett (Sheffield Univ., England.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 341-360 Original contains color illustrations (For primary document see N86-29301 20-42)

Avail: NTIS HC A20/MF A01 CSCL 04A

It has recently been demonstrated that the dramatic effects of plasma precipitation and convection on the composition and dynamics of the polar thermosphere and ionosphere include a number of strong interactive, or feedback, processes. To aid the evaluation of these feedback processes, a joint three dimensional time dependent global model of the Earth's thermosphere and ionosphere was developed in a collaboration between University College London and Sheffield University. This model includes self consistent coupling between the thermosphere and the ionosphere in the polar regions. Some of the major features in the polar ionosphere, which the initial simulations indicate are due to the strong coupling of ions and neutrals in the presence of strong electric fields and energetic electron precipitation are reviewed. The model is also able to simulate seasonal and Universal time variations in the polar thermosphere and ionospheric regions which are due to the variations of solar photoionization in specific geomagnetic regions such as the cusp and polar cap. Author

N86-29328*# Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.

PARTICLE PRECIPITAION INTO THE THERMOSPHERE (INVITED REVIEW) **c46**

Patricia H. Reiff *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 361-367 (For primary document see N86-29301 20-42)

Avail: NTIS HC A20/MF A01 CSCL 04A

A review of research on particle precipitation into the thermosphere is presented. Particle precipitation plays an important role in thermospheric dynamics, often being both the most important ionization source and the most important heat source, comparable to Joule heating rates in the auroral zones and typically exceeding solar ultraviolet as an ionization mechanism in the nightside auroral zones and winter polar caps. Rees (1963) has shown that, roughly speaking, one electron-ion pair is produced by each 35 eV of incident electron energy flux; thus, over half of the incident electron energy flux goes into heating rather than into ionization. Precipitating ions also can produce ionization, also requiring roughly 35 eV per pair; however, since ion energy fluxes are typically much weaker than electron fluxes, they have often been neglected. The particle precipitation into the thermosphere is both an important ionization source and an important heat source; since the globally integrated value can vary over more than a factor of ten, and the instantaneous local rate can vary over nearly three orders of magnitude global, maps of precipitation rates are extremely important for predicting thermospheric weather. Author

N86-29329*# Utah State Univ., Logan. Center for Atmospheric and Space Sciences.

A METHOD FOR EXTRACTING MERIDONAL WINDS FROM IONOSONDE MEASUREMENTS BY USING IONOSPHERIC MODELS **c46**

P. G. Richards and D. G. Torr *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 369-374 (For primary document see N86-29301 20-42)

Avail: NTIS HC A20/MF A01 CSCL 04A

There has been great progress in modelling and measuring the dynamics of the neutral upper atmosphere in recent years. However, future progress will depend on the availability of global measurements of neutral winds. Attention is drawn to a relatively cheap means of supplementing the data base of neutral winds provided by radar and optical measurements with data obtained by ionosondes. Rishbeth in his review of F-region dynamics, derived the relationship between the height of the F2 layer and the component of the neutral wind parallel to the magnetic field of the Earth. The sensitivity is examined of the height and density of the F2 layer over Boulder, Colorado on 30 July 1982 to changes in meridional wind speed using a comprehensive interhemispheric numerical model that solves the continuity and momentum

equations for H+ and O+, the energy equations for Te and Ti, and the 2-stream photoelectron equations to obtain electron heating rates. For the neutral atmosphere temperature and densities, the mass spectrometer incoherent scatter radar model of Hedin was used. Author

N86-29330*# Southampton Univ. (England). Dept. of Physics.
THE QUADRUPOLE IONOSPHERE c46
H. Rishbeth *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 375-377 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

The principal features that might exist in the terrestrial paleoionosphere, if the geomagnetic field were to assume a quadrupole form during a polarity reversal are discussed. Complicated phenomena would be expected to occur at magnetic equators and magnetospherically-driven plasma convection might occur at latitudes where the magnetic field is steeply inclined. The influence of magnetic field strength on ionospheric structure is considered in general terms. Author

N86-29331*# Science Research Council, Chilton (England). Rutherford Appleton Lab.
EISCAT VELOCITY PATTERNS FOR THEORETICAL PLASMA CONVECTION MODELS c46
H. Rishbeth and J. J. Sojka (Utah State Univ., Logan.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 379-382 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

Theoretical line-of-sight velocities, as would be observed by the EISCAT radar, are computed for idealized models of plasma convection in the polar ionosphere. The calculations give the velocity as a function of range and Universal Time. For several variants of the Volland and Heelis convection models, how the maxima, minima and reversals of velocity depend on beam azimuth is examined. The analysis is designed to be applied to data from the UK-POLAR experiment, an example of which is shown. Author

N86-29332*# National Center for Atmospheric Research, Boulder, Colo. High Altitude Observatory.
RESULTS OF VARIOUS STUDIES MADE WITH THE NCAR THERMOSPHERIC GENERAL CIRCULATION MODEL (TGCM) (INVITED REVIEW) c46
R. G. Roble *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 383-413 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

The NCAR thermospheric general circulation model (TGCM) has been used for a variety of thermospheric dynamic studies. It has also been used to compare model predictions with measurements made from various ground-based Fabry-Perot interferometer stations, incoherent scatter radar stations and the Dynamics Explorer satellites. The various input and output features of the model are described. These include the specification of solar EUV fluxes, and descriptions of empirical models to specify auroral particle precipitation, ion drag, and magnetospheric convection. Results are presented for solstice conditions giving the model perturbation temperature and circulation response to solar heating forcing alone and along with the inclusion of magnetospheric convections for two different dawn-dusk potential drops 20 and 60 kV respectively. Results at two constant pressure levels Z = +1 at 300 km and Z= -4 at 120 km are presented for both the winter and summer polar cap regions. The circulation over the Northern Hemisphere polar cap in both the upper and lower thermosphere are presented along with a figure showing that the circulation is mainly a non-divergent irrotational flow responding to ion drag. The results of a study made on the Southern Hemisphere polar cap during October 1981 where Dynamics Explorer satellite measurements of winds, temperature and composition are compared to TGCM predictions are also presented. A diagnostic package that has been developed to analyze the balance of forces operating in the TGCM is presented next illustrating that in the F-region ion drag and pressure provide the main force balance and in the E-region ion drag, pressure and the coriolis forces provide the main balance. The TGCM prediction for the June 10, 1983 total solar eclipse are next presented showing a thermospheric disturbance following the path of totality. Finally, results are presented giving the global circulation, temperature and composition structure of the thermosphere for solar minimum conditions at equinox with 60 kV magnetospheric convection forcing at high latitudes. Author

N86-29333*# Massachusetts Inst. of Tech., Cambridge. Haystack Observatory.
MILLSTONE HILL MEASUREMENTS AND TGCM SIMULATION FOR THE 30 MAY 1984 ANNULAR SOLAR ECLIPSE c46
J. E. Salah, W. L. Oliver, B. A. Emery (National Center for Atmospheric Research, Boulder, Colo.), R. G. Roble, E. C. Ridley, and H. C. Carlson (Air Force Geophysics Lab., Hanscom AFB, Mass.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 415-438 Original contains color illustrations (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

On 30 May 1984, the Millstone Hill incoherent scatter radar was operated to gather data on the effects of the annular solar eclipse on the structure and dynamics of the ionosphere and thermosphere. The eclipse path was about 3 deg. south of Millstone which experienced a maximum obscuration of 86% at about 1705 UT. Both the zenith steerable antennas at Millstone were used in the experiment to collect data on the temporal evolution of the eclipse effects. This experiment represented the first opportunity at Millstone to collect data during an eclipse in the absence of a major magnetospheric disturbance which had previously made the unravelling of eclipse effects difficult. In addition, the configuration of the experiment and analysis of the data included a detailed examination of the effects on the neutral atmosphere. A major catalyst for this study was the opportunity to compare the results with the predictions made from the Thermospheric General Circulation Model (TGCM) at NCAR, as a calibration point for the model. The Arecibo and Sondrestrom radars also participated as part of a radar chain experiment. The analysis of the data from these stations is in progress; the initial results from Millstone Hill are presented. Author

N86-29334*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A DYNAMO THEORY PREDICTION FOR SOLAR CYCLE 22: SUNSPOT NUMBER, RADIO FLUX, EXOSPHERIC TEMPERATURE, AND TOTAL DENSITY AT 400 km c46
K. H. Schatten and A. E. Hedin *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 439-444 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

Using the dynamo theory method to predict solar activity, a value for the smoothed sunspot number of 109 + or - 20 is obtained for solar cycle 22. The predicted cycle is expected to peak near December, 1990 + or - 1 year. Concommitantly, F(10.7) radio flux is expected to reach a smoothed value of 158 + or - 18 flux units. Global mean exospheric temperature is expected to reach 1060 + or - 50 K and global total average total thermospheric density at 400 km is expected to reach 4.3 x 10 to the -15th gm/cu cm + or - 25 percent. Author

N86-29335*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A THREE DIMENSIONAL MODEL OF THE VENUSIAN THERMOSPHERE WITH SUPERROTATION c91
D. R. Stevens-Rayburn (Applied Research Corp., Landover, Md.), H. G. Mayr, and I. Harris *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 445-450 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 03B

An improved three dimensional spectral model of the thermo-

sphere of Venus is described. The model solves the Navier-Stokes equations and includes nonlinear effects for an arbitrary number of atmospheric species. A two dimensional axisymmetric model of the superrotation of the thermosphere is also presented. This model addresses the Pioneer-Venus mission finding, which suggested the thermospheric rotation rate to be much higher than that of the planet as seen from the asymmetric distribution of hydrogen and helium. Both models include the effects of an anisotropic eddy diffusion that is consistent with atmospheric mixing length theory. Author

N86-29336*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
JOULE HEATING AND FIELD-ALIGNED CURRENTS: PRELIMINARY RESULTS FROM DE-2 **c46**
M. Sugiura *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 451-461 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

There are three main processes by which energy is transferred from the magnetosphere to the thermosphere: (1) charge exchange of the ring current particles; (2) precipitation of charged particles; and (3) joule dissipation by the magnetosphere-ionosphere current systems. The importance of this last process has been recognized and the rate of joule heating has been estimated by many workers. Observations of the electric (E) and magnetic (B) fields from Dynamics Explorer Satellite 2 are providing a new set of data on field-aligned currents. One of the remarkable features found in these observations is the high correlation between an orthogonal pair of the E and B field components. In recent years, observational data have accrued concerning the relationship between the interplanetary magnetic field and the size of the polar cap and also about the evolution of a substorm or a magnetic storm. It is suggested that these findings be incorporated in future model calculations. Author

N86-29337*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OBSERVATIONS OF COMPOSITION FROM PIONEER VENUS **c91**
H. A. Taylor, Jr. *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 463-465 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 03B

Long latitude distributions of atmospheric neutral hydrogen were derived at Venus for the period 1979 to 1980. In-situ measurements of H+, O+, O, and CO2 obtained from the ion and neutral mass spectrometers on the Pioneer Venus orbiter are combined with the appropriate chemical equilibrium relationship to determine the abundance of neutral hydrogen which is very difficult to measure directly. The measurements are all obtained below 165 km on the nightside and below 200 km on the dayside, based on evidence for chemical equilibrium prevailing up to those altitudes. During the period examined nearly three complete diurnal cycles were available and a comparison of the year-to-year variation in hydrogen content is made across the dawn region where the distributions of light gases are most pronounced. The dawn bulge in H (and also in He) which was reported from the first diurnal cycle by Brinton et al. is found to persist. Superimposed upon the diurnal variation are strong day-to-day variations in which n(H) changes by as much as a factor of five. Such variations are linked to pronounced changes in the ion and neutral composition which sometimes occur in association with solar wind disturbances passing the planet. The interaction of the solar wind and the planetary environment somehow results in large changes in the relative abundances and scale heights of the ion and neutral species, thus modifying the derived values of n(H). These variations in the ion distributions are not surprising owing to the strong dependence of the nightside ionization upon convection from the dayside and associated sensitivity of this convection to changes in solar wind pressure and interplanetary magnetic field variations. The variation exhibited by the neutrals, however, appears to require some other explanation owing to the limited momemtum transfer between the ions and neturals. Allowing for these short term perturbations, there appears to be no clear evidence for interannual variation in n(H) during the period examined, apparently consistent with the very small change in solar EUV flux over the same interval. Author

N86-29338*# York Univ. (England). Centre for Research in Experimental Space Science.
WAMDII OBSERVATION OF AN AURORAL ATMOSPHERE WAVE EVENT **c46**
R. H. Wiens, G. G. Shepherd, and K. V. Paulson (Saskatchewan Univ., Saskatoon.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 467 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

Field tests of WAMDII (Wide Angle Michelson Doppler Imaging Interferometer) on February 23 to 24, 1984 in Saskatoon produced wind images of the aurora that show well defined wave structures in lambda 5577. Wavelengths and velocities of these structures suggest an acoustic-gravity wave interpretation, but their short duration warrants their being termed an event. The Dopplergrams are presented with emphasis on the interpretation of the waves and a discussion of possible sources. Author

N86-29463# Delaware Univ., Lewes.
THE OVERALL PLAN: A SCIENTIFIC STRATEGY
Ferris Webster *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 5 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

N86-29464# World Meteorological Organization, Geneva (Switzerland).
NATIONAL AND REGIONAL ACTIVITIES RELATED TO THE TROPICAL OCEAN GLOBAL ATMOSPHERE (TOGA) PROJECT
In its International Conference on the TOGA Scientific Program Sep. 1985 62 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

43 EARTH RESOURCES

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N86-29339# Danish Meteorological Inst., Copenhagen.
SNOW PACK MAXIMUM WATER EQUIVALENT IN DENMARK: EVALUATED BY A SIMULATION MODEL
Peter Allerup, Henning Madsen, Bent Hasholt, and Henrik Sogaard 1985 52 p
(DMI-CP-14; ISBN-87-7478-258-4) Avail: NTIS HC A04/MF A01

In 1981 the Danish Meteorological Institute (MI) received a request from the Codes of Practice Committee to prepare an update on snow loads. Snow loads provide the governing load requirements for the structural design of roofs, hence a correct evaluation of snow loads will be of economic interest. MI agreed to participate and the resources required for an investigation of water equivalent of maximal snowfall were provided. The project started November 1982 and was finished October 1984. B Hansen and J. J. Riis (Geographic Institute) and A. Rasmussen (Meteorological Institute) have all been engaged in problems concerning data processing as well as the important task of implementing the simulation program on the UNIVAC 1100 computer. Author

N86-29340# Environmental Research Inst. of Michigan, Ann Arbor.
CALIBRATED L-BAND TERRAIN MEASUREMENTS AND ANALYSIS PROGRAM Interim Report, Apr. 1984 - Apr. 1985
R. W. Larson, E. S. Kasischke, and A. Maffett Feb. 1986 157 p
(Contract F19628-84-C-0081)
(AD-A165916; ERIM-174200-5-P; RADC-TR-85-266) Avail: NTIS HC A08/MF A01 CSCL 08/6

This report presents the initial results of a three year program for the collection and analysis of L-band calibrated backscatter data from various terrain types. During the first year advantages was taken of two SAR data collection programs to obtain ground measurements simultaneously with the SAR flights. These data collection flights were conducted in North Carolina during April 1984 sponsored by USGS and during August - September 1984 in Long Island, sponsored by ONR. Ground data were collected at specific sites during both SAR flights and included measurement of dielectric constant, surface roughness and moisture. The reduction of ground data and the calibration of the SAR are described. Calibration of the SAR has been verified and an error of less than 3 dB in absolute calibration of the L-band channel demonstrated. GRA

N86-29341# Lawrence Livermore National Lab., Calif.
CONTOUR-TO-GRID METHODS FOR THE ARAC SYSTEM
J. F. Barbieri Dec. 1985 15 p Presented at the Geographic Information Systems in the Government Workshop, Springfield, Va., 10 Dec. 1985
(Contract W-7405-eng-48)
(DE86-004919; UCRL-93415; CONF-851252-1) Avail: NTIS HC A02/MF A01

By combining a digitizing system with a contour-to-grid program, digital elevation data may be developed from contour maps automatically for any existing contour map. DOE

N86-29342# Department of Energy, Morgantown, W. Va.
DEEP SOURCE GAS Technology Status Report
Jan. 1986 29 p
(DE86-001036; DOE/METC-86-0234) Avail: NTIS HC A03/MF A01

Deep source gas research exists to verify that natural gas can exist at depths in excess of 30,000 feet, to relate these occurences to conceptual models, to define the limits of target areas, to quantify the resource, and to determine the potential significance of such finds on the nation's future gas supply. There are three separate emplacement concepts that could explain the occurrence of gas at extreme depths: abiogenic gas; subducted, organic-origin gas; and deep sedimentary basin gas. Of these concepts, deep source gas research focuses on the subducted, organic-origin concept. The research emphasizes an earth science study (geochemistry, and geophysics) of the Cordilleran Geologic Province of western North America. Detailed geochemical studies have indicated that the deep-source, gas-generating capacity of the Aleutian Trench area of southern Alaska may be high. A new technique has helped determine that methane gas can exist at depths up to 40,000 feet. This new technique uses a combination of theoretical computer modeling and laboratory experiments with test rock samples that contain fluid inclusions. DOE

N86-29343# Department of Energy, Morgantown, W. Va.
GAS HYDRATES: TECHNOLOGY STATUS REPORT
Jan. 1986 37 p
(DE86-001037; DOE/METC-86-0230) Avail: NTIS HC A03/MF A01

The DOE Morgantown Energy Technology Center (METC) implemented a gas hydrates R and D program that emphasized an understanding of the resource through (1) an assessment of current technology, (2) the characterization of gas hydrate geology and reservoir engineering, and (3) the development of diagnostic tools and methods. Recovery of natural gas from gas hydrates will be made possible through (1) improved instrumentation and recovery methods, (2) developing the capability to predict production performance, and (3) field verification of recovery methods. Gas hydrates research has focused primarily on geology. As work progressed, areas where gas hydrates are likely to occur were identified, and specific high potential areas were targeted for detailed investigation. A Geologic Analysis System (GAS) was developed. GAS contains approximately 30 software packages and can manipulate and correlate several types of geologic and petroleum data into maps, graphics, and reports. The system also contains all well information currently available from the Alaskan North Slope area. Laboratory research on gas hydrates includes the characterization of the physical system, which focuses on creating synthetic methane hydrates and developing synthetic hydrate cores using tetrahydrofuran (THF), consolidated rock cores, frost base mixtures, water/ice-base mixtures, and water-base mixtures. Laboratory work produced measurements of the sonic velocity and electrical resistivity of these synthetic hydrates. During 1983, a sample from a natural hydrate core recovered from the Pacific coast of Guatemala was tested for these properties by DOE/METC. More recently, natural hydrate samples acquired from the Gulf of Mexico are being tested. Modeling and systems analysis work has focused on the development of GAS and preliminary gas hydrate production models. DOE

N86-29344# Department of Energy, Morgantown, W. Va.
GEOLOGICAL OCCURRENCE OF GAS HYDRATES AT THE BLAKE OUTER RIDGE, WESTERN NORTH ATLANTIC
K. L. Dominic and D. L. Barlow Mar. 1986 28 p
(DE86-001078; DOE/METC-86-2024) Avail: NTIS HC A03/MF A01

The occurrence of gas hydrates at the Blake Outer Ridge, as confirmed by the Deep Sea Drilling Project (DSDP), is governed not only by gas-water phase relationships but also by interrelated geological constraints. The results of this reexamination of the DSDP data show that seafloor processes, topography, and sediment properties are among the factors that impact the stability and distribution of gas hydrate at the ridge. Rapid sedimentation and erosion have local and transient effects on thermal gradients, which cause the base of the hydrate stability zone to migrate. To a large degree, the convex shape of the Blake Outer Ridge allows gas hydrates to be stable. Low-permeability sediments occupy the interval in which the stability zone exists, and they influence hydrate occurrence by controlling the distribution of gas. A brief comparison of the Blake Outer Ridge with two more recently confirmed hydrate localities (the northern Gulf of Mexico and the Middle America's trench) shows little similarity among the three hydrate environments, but calls attention to the complex and often subtle effects that the geological system imposes on hydrate stability. DOE

N86-29345# World Meteorological Organization, Geneva (Switzerland).
GUIDELINES FOR COMPUTERIZED DATA PROCESSING IN OPERATIONAL HYDROLOGY AND LAND AND WATER MANAGEMENT
1985 223 p Prepared in cooperation with Food and Agriculture Organization of the UN
(WMO-634; ISBN-92-63-10634-7; ESA-86-97078) Avail: NTIS MF A01; HC from WMO, Geneva, Switzerland

The guidelines for computerized data processing in operational hydrology and land and water management introduces to land and water experts the concepts, terminology, and application of computerized data processing. The Guidelines are designed for operational use by national hydrological services, field projects and experts of WMO and FAO. ESA

N86-29346# Geological Survey, Iowa City, Iowa. Water Resources Div.
WATER RESOURCES DATA FOR IOWA, WATER YEAR 1984 Annual Water-Data Report, 1 Oct. 1983 - 30 Sep. 1984
V. E. Miller, W. J. Matthes, M. G. Detroy, and R. E. Hansen 8 Jul. 1985 274 p
(PB86-173077; USGS/WRD/HD-85/263; USGS/WDR/IA-84/1) Avail: NTIS HC A12/MF A01 CSCL 08H

Water resources data for the 1984 water year for Iowa consists of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; ground-water levels; and ground-water quality. Discharge records for 115 gaging stations; stage and contents for 7 lakes and reservoirs; water quality for 17 gaging stations; and water levels for 90 observation wells are given. Also included are 120 crest-stage partial-record stations. GRA

N86-29181 Technische Univ., Hanover (West Germany).
INVESTIGATIONS OF SYSTEMATIC IMAGE DEFECTS NOT TAKEN INTO ACCOUNT IN AEROTRIANGULATION [UNTERSUCHUNG NICHT BERUECKSICHTIGTER SYSTEMATISCHER BILDFEHLER BEI AEROTRIANGULATIONEN]
K. Jacobsen *In* Deutsche Geodaetische Kommission Camera Calibration in Photogrammetric Practice 1985 p 65-71 In GERMAN (For primary document see N86-29175 20-35)
Avail: Issuing Activity

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells and batteries; global sources of energy; fossil fuels; geophysical conversion; hydroelectric power; and wind power.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *85 Urban Technology and Transportation.*

N86-29347*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROCEEDINGS OF THE 25TH PROJECT INTEGRATION MEETING Progress Report, Oct. 1984 - Jun. 1985
M. Phillips Jun. 1985 674 p Meeting held in Pasadena, Calif., 19-20 Jun. 1985
(Contracts NAS7-918; DE-AI01-85CE-89008)
(NASA-CR-176815; JPL-5101-271; DOE/JPL-1012-119; JPL-Publ-86-4; NAS 1.26:176815; PR-25) Avail: NTIS HC A99/MF E03 CSCL 10A

Topics addressed include: silicon sheet growth and characterization, silicon material, process development, high-efficiency cells, environmental isolation, engineering sciences, and reliability physics. For individual titles, see N86-29348 through N86-29408.

N86-29348*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FSA FUTURE DIRECTIONS: RELIABILITY AND ENGINEERING SCIENCES FY85-FY86 ACTIVITIES AND PLANS
R. G. Ross, Jr. *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 75-81 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Objectives were listed for four areas: engineering science, reliability physics, module development, and module performance and failure analysis. The engineering science efforts are to develop module design requirements for large-scale photovoltaic (PV) applications and to develop generic module and array design and construction technology to meet the needed performance, safety, reliability, and system interfaces. The reliability physics effort is to develop the technology for 30-year life modules. The module development efforts are to transfer new technology to PV manufacturers and their products, and to evaluate these advanced modules. The module performance and failure analysis efforts are to determine PV module performance, to identify needed development, and to assess suitability for large-scale use. B.G.

N86-29349*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
FSA FUTURE DIRECTIONS: FSA TECHNOLOGY ACTIVITIES IN FY86
M. H. Leipold *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 83-86 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The silicon material, advanced silicon sheet, device research, and process research activities are explained. There will be no new initiatives. Many activities are targeted for completion and the emphasis will then be on technology transfer. Industrial development of the fluidized-bed reactor (FBR) deposition technology is proceeding. Technology transfer and industry funding of sheet development are continuing. B.G.

N86-29350*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SUMMARY OF HIGH-EFFICIENCY SOLAR-CELL RESEARCH
Ram Kachare *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 87-92 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

High-efficiency solar-cell activities supporting efforts to achieve the DOE Five-Year Plan goals are summarized. Specific objectives are to identify and resolve key generic problems that limit cell efficiency to below theoretically predicted values and to design and fabricate cells having efficiences equal to or greater than 20% (AM1.5). Theoretical curves for various p-n junction cells were shown. The effects of practical barriers on cell efficiency was depicted along with the modeling parameters. Cell design parameters used in the analyses were described. The usefulness and present limitations of the existing modeling capabilities were presented. The historical evolution of the efficiencies of cells made from web and edge-defined film-fed growth (EFG) silicon ribbons were also described. The status of contemporary higher-efficiency technical capabilities and future activities to raise efficiencies were stated. Author

N86-29351*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OVERVIEW OF PROCESSING ACTIVITIES AIMED AT HIGHER EFFICIENCIES AND ECONOMICAL PRODUCTION
D. B. Bickler *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 93-98 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

An overview of processing activities aimed at higher efficiencies and economical production were presented. Present focus is on low-cost process technology for higher-efficiency cells of up to 18% or higher. Process development concerns center on the use of less than optimum silicon sheet, the control of production yields, and making uniformly efficient large-area cells. High-efficiency cell factors that require process development are bulk material perfection, very shallow junction formation, front-surface passivation, and finely detailed metallization. Better bulk properties of the silicon sheet and the keeping of those qualities throughout large areas during cell processing are required so that minority carrier lifetimes are maintained and cell performance is not degraded by high doping levels. When very shallow junctions are formed, the process must be sensitive to metallizatin punch-through, series resisitance in the cell, and control of dopant leaching during surface passivation. There is a need to determine the sensitivity to processing by mathematical modeling and experimental activities. Author

N86-29352*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SUMMARY OF PROCESS RESEARCH ANALYSIS EFFORTS
Dale R. Burger *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 99-103 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

A summary of solar-cell process research analysis efforts was presented. Process design and cell design are interactive efforts where technology from integrated circuit processes and other processes are blended. The primary factors that control cell efficiency are: (1) the bulk parameters of the available sheet material, (2) the retention and enhancement of these bulk parameters, and (3) the cell design and the cost to produce versus the finished cells performance. The process sequences need to be tailored to be compatible with the sheet form, the cell shape form, and the processing equipment. New process options that require further evaluation and utilization are lasers, robotics, thermal pulse techniques, and new materials. There are numerous process

control techniques that can be adapted and used that will improve product uniformity and reduced costs. Two factors that can lead to longer life modules are the use of solar cell diffusion barriers and improved encapsulation. Author

N86-29353*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
METALLO-ORGANIC DECOMPOSITION FILMS
B. D. Gallagher *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 105-110 (For primary document see N86-29347 20-44)
Avail; NTIS HC A99/MF E03 CSCL 10A

A summary of metallo-organic deposition (MOD) films for solar cells was presented. The MOD materials are metal ions compounded with organic radicals. The technology is evolving quickly for solar cell metallization. Silver compounds, especially silver neodecanoate, were developed which can be applied by thick-film screening, ink-jet printing, spin-on, spray, or dip methods. Some of the advantages of MOD are: high uniform metal content, lower firing temperatures, decomposition without leaving a carbon deposit or toxic materials, and a film that is stable under ambient conditions. Molecular design criteria were explained along with compounds formulated to date, and the accompanying reactions for these compounds. Phase stability and the other experimental and analytic results of MOD films were presented. Author

N86-29354*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DIRECTED-ENERGY PROCESS TECHNOLOGY EFFORTS
Paul Alexander *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 111-122 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

A summary of directed-energy process technology for solar cells was presented. This technology is defined as directing energy or mass to specific areas on solar cells to produce a desired effect in contrast to exposing a cell to a thermal or mass flow environment. Some of these second generation processing techniques are: ion implantation; microwave-enhanced chemical vapor deposition; rapid thermal processing; and the use of lasers for cutting, assisting in metallization, assisting in deposition, and drive-in of liquid dopants. Advantages of directed energy techniques are: surface heating resulting in the bulk of the cell material being cooler and unchanged; better process control yields; better junction profiles, junction depths, and metal sintering; lower energy consumption during processing and smaller factory space requirements. These advantages should result in higher-efficiency cells at lower costs. The results of the numerous contracted efforts were presented as well as the application potentials of these new technologies. Author

N86-29355*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
CRYSTAL GROWTH FOR HIGH-EFFICIENCY SILICON SOLAR CELLS WORKSHOP: SUMMARY
Katherine A. Dumas *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 123-136 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The state of the art in the growth of silicon crystals for high-efficiency solar cells are reviewed, sheet requirements are defined, and furture areas of research are identified. Silicon sheet material characteristics that limit cell efficiencies and yields were described as well as the criteria for the ideal sheet-growth method. The device engineers wish list to the material engineer included: silicon sheet with long minority carrier lifetime that is uniform throughout the sheet, and which doesn't change during processing; and sheet material that stays flat throughout device processing, has uniform good mechanical strength, and is low cost. Impurities in silicon solar cells depreciate cell performance by reducing diffusion length and degrading junctions. The impurity behavior, degradation mechanisms, and variations in degradation threshold with diffusion length for silicon solar cells were described. Author

N86-29356*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RELIABILITY AND ENGINEERING OF THIN-FILM PHOTOVOLTAIC MODULES
E. L. Royal *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 137-143 Previously announced as N86-12759 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Objectives were to: examine thin-film cell attributes that influence module performance and reliability, explore the lessons and applicability of crystalline-silicon module technology to thin-film modules, review the current status of thin-film module technologies, and identify problem areas and needed research. A major need is to separate the effects and resons for reversible degradatin from nonreversible degradation. Amorphous-silicon (a-Si) reliability investigations are focusing on exploratory research investigations, accelerated Arrhenius-type testing of a-Si cells, real-time outdoor exposure testing of a-Si cells, cell failure analysis, and failure mechanism research. Studies included the reduction in strength of glass by high temperature depositions on glass and laser scribing, encapsulation materials development needs, and the testing of modules. The new materials and processes in thin-film modules will require a delinquent reliability effort, including: establishment of mechanism-specific reliability goals; quantification of mechanism parameter dependencies; prediction of expected long-term degradation; identification of cost-effective solutions; and testing and failure analysis of trial solutions. Author

N86-29357*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PHOTOTHERMAL DEGRADATION STUDIES
Ranty H. Liang *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 151-156 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Key reaction intermediates of photooxidation identified and characterized by laser flash Electron Spin Resonance (ESR) spectroscopy were discussed. Effects of temperature and ultraviolet intensity were studied in order to develop meaningful accelerated testing procedures for encapsulant evaluation. In a program to study the failure of Tedlar/ethylene vinyl acetate (EVA)/stainless steel modules, failure modes similar to those observed outdoors in real-time conditions were simulated in accelerated testing. An experimental technique was developed to quantitatively assess the extent of degradation. Author

N86-29358*# Cincinnati Univ., Ohio.
PHOTOVOLTAICS MODULE INTERFACE: GENERAL PURPOSE PRIMERS
J. Boerio *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 157-168 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The interfacial chemistry established between ethylene vinyl acetate (EVA) and the aluminized back surface of commercial solar cells was observed experimentally. The technique employed is called Fourier Transform Infrared (FTIR) spectroscopy, with the infrared signal being reflected back from the aluminum surface through the EVA film. Reflection infrared (IR) spectra are given and attention is drawn to the specific IR peak at 1080/cm which forms on hydrolytic aging of the EVA/aluminum system. With this fundamental finding, and the workable experimental techniques, candidate silane coupling agents are employed at the interface, and their effects on eliminating or slowing hydrolytic aging of the EVA/aluminum interface are monitored. Author

N86-29359*# Springborn Labs., Inc., Enfield, Conn.
ENCAPSULATION MATERIALS RESEARCH
P. Willis *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 169-190 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The successful use of outdoor mounting racks as an acceler-

ated aging technique (these devices are called optal reactors); a beginning list of candidate pottant materials for thin-film encapsulation, which process at temperatures well below 100 C; and description of a preliminary flame retardant formulation for ethylene vinyl acetate which could function to increase module flammability ratings are presented. Author

N86-29360*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MOISTURE-TEMPERATURE DEGRADATION IN MODULE ENCAPSULANTS: THE GENERAL PROBLEM OF MOISTURE IN PHOTOVOLTAIC ENCAPSULANTS
G. R. Mon *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 191-199 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

A general research approach was outlined toward understanding water-module interactions and the influence of temperature involving the need to: quantify module performance loss versus level of accumulated degradation, establish the dependence of the degradation reaction rate on module moisture and temperature levels, and determine module moisture and temperature levels in field environments. These elements were illustrated with examples drawn from studies of the now relatively well understood module electrochemical degradation process. Research data presented include temperature and humidity-dependent equilibrium leakage current values for multiparameter module material and design configurations. The contributions of surface, volume, and interfacial conductivities was demonstrated. Research directions were suggested to more fully understand the contributions to overall module conductivity of surface, volume, and interfacial conductivities over ranges of temperature and relative humidity characteristic of field environments. Author

N86-29361*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PRELIMINARY STUDY: MOISTURE-POLYMER INTERACTION. STUBY OBJECTIVES
L.-C. Wen *In its* Prceedings of the 25th Project Integration Meeting Jun. 1985 p 201-216 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The problems associated with mathematically modeling water-module interaction phenomena, including sorption and desorption, diffusion, and permeation are discussed. With reliable analytical models, an extensive materials data base, and solar radiation surface meteorological observations (SOLMET) weather data, predicting module lifetimes in realistic environments can become a practical reality. The status of the present techniques of simulating the various transport mechanisms was reported. The Dent model (a modified Brunauer-Emmet-Teller) approach represented polyvinyl butyral (PVB) sorption data. A 100-layer material model and Fick's diffusion model gave diffusivity values exhibiting adequate agreement with those measured for PVB. Diffusivity of PVB is concentration dependent, decreasing as the water content in PVB increases. The temperature dependence of diffusion in PVB is well modeled by the Arrhenius rate equation. Equilibrium conductivity and leakage current data are well represented by Hearle's model for bulk ionic conductivity. A nodal network analysis using the Systems Improved Numerical Differencing Analyzer (SINDA) Thermal Analyzer gave reasonable correlation with measurable data. It is concluded that realistic lifetime predictions seem to be feasible. Author

N86-29362*# Wilkes Coll., Wilkes-Barre, Pa.
WATER PERMEATION AND DIELECTRIC BREAKDOWN. WATER PERMEABILITY IN PUB TEDLAR. PUB/TEDLAR AS A FUNCTION OF TEMPERATURE AND HUMIDITY
John Orehotsky *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 217-233 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Moisture transport and dielectric breakdown of polyvinyl butyral (PVB), Tedlar, and PVB/Tedlar composites were addressed. Data for the temperature range between 20 and 80 C showed that the moisture flux through the composite is governed by the slower material; and that the composite permeability is intermediate to those of the component material, as predicted by theory. Data for Tedlar at 71 C, showing the dependence of moisture flux on relative humidity, was also presented. Dielectric breakdown data were less precise and less conclusive. The generally applied theoretical model does not match the experimental data. The PVB/Tedlar composite exhibited greater voltage breakdown resistance than either component. Testing of EVA and EVA/Tedlar composites is underway. Author

N86-29363*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE (RH+t) AGING CORRELATION. ELECTRICAL RESISTIVITY OF PVB AT VARIOUS TEMPERATURES AND RELATIVE HUMIDITIES
E. F. Cuddihy *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 235-245 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Electrical products having organic materials functioning as pottants, encapsulants, and insulation coatings are commonly exposed to elevated conditions of temperature and humidity. In order to assess service life potential from this method of accelerated aging, it was empirically observed that service life seems proportional to an aging correlation which is the sum of temperature in degrees Celsius (t), and the relative humidity (RH) expressed in percent. Specifically, the correlation involves a plot of time-to-failure on a log scale versus the variable RH + T plotted on a linear scale. A theoretical foundation is provided for this empirically observed correlation by pointing out that the correlation actually involves a relationship between the electrical resistivity (or conductivity) of the organic material, and the variable RH + t. If time-to-failure is a result of total number of coulombs conducted through the organic material, then the correlation of resistivity versus RH + t is synonymous with the empirical correlation of time-to-failure versus RH + t. Author

N86-29364# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SILICON MATERIAL AND JPL WEB TEAM
Ralph Lutwack *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 247 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Silicon material activities are described. Topics discussed include: fluidized bed technology, model predictions (reaction kinetics and grid design parameters), seed-particle cleaning procedure, runaway nucleation, thermal analysis of dendritic ribbons, and residual stress in dendritic ribbons. B.G.

N86-29365# Union Carbide Corp., New York.
SILANE PROCESS RESEARCH AND DEVELOPMENT
S. Iya *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 249-254 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Progress in the program to develop fluidized-bed technology for the silane system is described. Quartz liners used in experimental runs continue to fail on cool-down. A modified reactor was designed to permit the use of commercially available quartz tubes and to improve the liner seals. Experiments with the new reactor will be done during the contract extension. Improvements in the cleaning procedure for the seed material were indicated by the purity measurements. In a 110-hour run at a silane concentration in the range of 20 to 30% in H2, several kilograms of product were obtained. A layered structure of the particles was found using scanning electron microscope (SEM) analyses. Author

N86-29366*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
JPL IN-HOUSE FLUIDIZED BED REACTOR RESEARCH

N. K. Rohatgi *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 255-259 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The progress in the in-house program on the silane fluidized-bed system is reported. A seed-particle cleaning procedure was developed to obtain material purity near the level required to produce a semiconductor-grade product. The liner-seal design was consistently proven to withstand heating/cooling cycles in all of the experimental runs. Author

N86-29367*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
WEB TEAM OVERVIEW
R. R. McDonald *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 261-262 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Analytical and experimental work were combined to develop a stress model to determine the temperature profile which will yield a satisfactory web. A thermal model of the web will be used to determine the thermal configuration which will yield the desired temperature profile. Thermal analysis of growth interface and the susceptor melt will be developed to determine a thermal configuration which will improve stability of growth process. The thermal configurations will be designed, fabricated, and tested and the results fed back into the models. B.G.

N86-29368# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SILICON DENDRITIC WEB GROWTH THERMAL ANALYSIS TASK
R. Richter and P. Bhandari *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 263-299 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

A thermal analysis model is presented which describes the dendritic ribbon process. The model uses a melt-dendrite interface which projects out of the bulk melt as the basic interpretation of the ribbon production process. This is a marked departure from the interpretations of the interface phenomena which were used previously. The model was extensively illustrated with diagrams and pictures of ribbon samples. This model should have great impact on the analyses of experimental data as well as on future design modifications of ribbon-pulling equipment. Author

N86-29369*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
HIGH-EFFICIENCY DEVICE RESEARCH
Dale R. Burger *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 299-300 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Progress on research in high-efficiency silicon solar cells is presented. Topics addressed include: recombination measurement techniques, doped crystals, minority carrier transport, oxygen process in solar cells, solar cell models, loss mechanics in solar cells, high-efficiency metal insulators, dendritic web cells, and surface and bulk loss reduction by low-energy hydrogen doping. B.G.

N86-29370*# Florida Univ., Gainesville.
HEAVY DOPING CONSIDERATIONS AND MEASUREMENTS IN HIGH-EFFICIENCY CELLS
F. Lindholm *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 301-311 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Theoretical work on heavily doped silicon was described. Heavily doped polysilicon was used as a back-surface passivant replacing the usual back-surface field (BSF). Very good first results were achieved and there is the promise of a simple, low temperature deposition process. Short-circuit current-decay measurement methods were also covered. Author

N86-29371*# Pennsylvania Univ., Philadelphia.
ADVANCED TECHNIQUES FOR THE MEASUREMENT OF MULTIPLE RECOMBINATION PARAMETERS IN SOLAR CELLS
M. Newhouse and M. Wolf *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 313-327 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

A survey of bulk recombination measurement techniques was presented. Classical methods were reviewed along with their limiting assumptions and simplifications. A modulated light measurement system was built and showed the large effects of junction capacitance. Techniques for extension of classical methods for measurement of multiparameter multiregression measurements were identified and analyzed. Author

N86-29372*# Stanford Univ., Calif.
MEASUREMENT OF MINORITY CARRIER TRANSPORT PARAMETERS IN HEAVILY DOPED n-TYPE SILICON
J. delAlamo and R. M. Swanson *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 329-337 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Measurement of minority transport parameters in heavily doped silicon is covered. The basic transport equations were used to define two independent parameters. Use of special vertical and lateral transistor test devices permitted the measurement of both parameters. Prior studies were normalized to show excellent agreement over the heavy doping region. Author

N86-29373*# State Univ. of New York, Albany.
STUDIES OF OXYGEN-RELATED AND CARBON-RELATED DEFECTS IN HIGH-EFFICIENCY SOLAR CELLS
James W. Corbett *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 339-348 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Oxygen and carbon related defects in silicon, particularly as related to high-efficiency silicon solar cells were studied. A summary of oxygen processes in silicon versus process temperature was shown along with experimental results. The anamolous diffusion of oxygen was explained by the dissociation of the center allowing O sub i to move through the lattices. Author

N86-29374*# Research Triangle Inst., Research Triangle Park, N.C.
COMPREHENSIVE SOLAR CELL MODELING AND CORRELATION STUDIES
M. L. Lamorte *In* JPL, Pasadena, Calif. Proceedings of the 25th 25th Project Integration Meeting Jun. 1985 p 349-371 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Modeling and correlation studies of solar cells was discussed. Recursive relationships were used to generate solutions at a number of mesh points within the emitter region. Photoexcited hole concentration and built-in electric field were calculated as a function of position. Simulated and experimentally determined I-V curves were shown to have good fit. Author

N86-29375*# Sah (C. T.) Associates, Urbana, Ill.
LOSS MECHANISMS IN HIGH-EFFICIENCY SOLAR CELLS: STUDY OF MATERIAL PROPERTIES AND HIGH-EFFICIENCY SOLAR-CELL PERFORMANCE ON MATERIAL COMPOSITION: PROJECT TASKS
C. Tang Sah *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 373-377 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Loss mechanisms in high-efficiency solar cells were discussed. Fundamental limitations and practical solutions were stressed. Present cell efficiency is limited by many recombination sites:

emitter, base, contacts, and oxide/silicon interface. Use of polysilicon passivation was suggested. After reduction of these losses, a 25% efficient cell could be built. A floating emitter cell design was shown that had the potential of low recombination losses. Author

N86-29376*# Washington Univ., Seattle.
HIGH-EFFICIENCY SILICON SOLAR CELLS
Larry C. Olsen *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 379-388 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Fabrication and characterization of high-efficiency metal insulator, n-p (MINP) cells is described. Particular attention was paid to development of measurement methods for surface recombination and density of surface states. A modified Rosier test structure was used successfully for density of surface states. Silicon oxide and silicon nitride passivants were studied. Heat treatment after plasma enhanced chemical vapor deposition (CVD) of silicon nitride was shown to be beneficial. A more optimum emitter concentration profile was modeled. Author

N86-29377*# Westinghouse Electric Corp., Pittsburgh, Pa.
DEVELOPMENT OF HIGH-EFFICIENCY SOLAR CELLS ON SILICON WEB
A. Rohatgi, D. L. Meier, R. B. Campbell, R. G. Seidensticker, and P. Rai-Choudhury *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 389-399 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

High-efficiency dendritic cells were discussed. The influence of twin planes and heat treatment on the location and effect of trace impurities was of particular interest. Proper heat treatment often increases efficiency by causing impurities to pile up at twin planes. Oxide passivation had a beneficial effect on efficiency. A very efficient antireflective (AR) coating of zinc selenide and magnesium fluoride was designed and fabricated. An aluminum back-surface reflector was also effective. Author

N86-29378*# Pennsylvania State Univ., University Park.
SURFACE AND BULK-LOSS REDUCTION RESEARCH BY LOW-ENERGY HYDROGEN DOPING
S. Fonash *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 401-407 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Surface and bulk loss reduction by low energy hydrogen doping of silicon solar cells was examined. Hydrogen ions provided a suppression of space charge recombination currents. Implantation of hydrogen followed by the anneal cycle caused more redistribution of boron than the anneal which could complicate processing. It was demonstrated that passivation leads to space charge current reduction. Author

N86-29379*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
PROCESS DEVELOPMENT
Donald B. Bickler *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 409-411 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

An overview is given of seven process development activities which were presented at this session. Pulsed excimer laser processing of photovoltaic cells was presented. A different pulsed excimer laser annealing was described using a 50 w laser. Diffusion barrier research focused on lowering the chemical reactivity of amorphous thin film on silicon. In another effort adherent and conductive films were successfully achieved. Other efforts were aimed at achieving a simultaneous front and back junction. Microwave enhanced plasma deposition experiments were performed. An updated version of the Solar Array Manufacturing Industry Costing Standards (SAMICS) was presented, along with a life cycle cost analysis of high efficiency cells. The last presentation was on the evaluation of the ethyl vinyl acetate encapsulating system. E.R.

N86-29380*# ARCO Solar, Inc., Chatsworth, Calif.
PULSED EXCIMER LASER PROCESSING
David Wong *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 413-428 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The status of pulsed excimer laser processing of PV cells is presented. The cost effective feasibility of fabricating high efficiency solar cells on Czochralski wafers using a pulsed excimer laser for junction formation, surface passivation, and front metallization. Laser annealing results were promising with the best AR coated cell having an efficiency of 16.1%. Better results would be expected with larger laser spot size because there was some degradation in open circuit voltage caused by laser spot overlap and edge effects. Surface heating and photolytic decomposition by the laser was used to deposit tungsten from the reaction of tungsten hexafluoride and hydrogen. The line widths were 5 to 10 mils, and the depositions passed the tape adhesion test. Thinner lines are practical using an optimized optical system. Author

N86-29381*# Spire Corp., Bedford, Mass.
EXCIMER LASER ANNEALING FOR FABRICATION OF LOW-COST SOLAR CELLS
M. B. Spitzer, A. C. Greenwald, and S. J. Hogan *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 429-434 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Pulsed excimer laser annealing was successfully performed using a 50 w laser. Both polished and texturized cells were tried, however, there are serious problems with nonuniformity on texturized cells. A number of cells were produced and compared to diffusion furnace annealed cells. There was no clear economic advantage in using an excimer laser and there was a small penalty on average efficiency. The conclusion was that the excimer laser anneal process must be able to produce superior cells to be considered as a viable process option. Author

N86-29382*# California Inst. of Tech., Pasadena.
AMORPHOUS METALLIC FILMS IN SILICON METALLIZATION SYSTEMS
Frank So, Elzbieta Kolawa, and Marc-A. Nicolet *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 435-441 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Diffusion barrier research was focussed on lowering the chemical reactivity of amorphous thin films on silicon. An additional area of concern is the reaction with metal overlays such as aluminum, silver, and gold. Gold was included to allow for technology transfer to gallium arsenide PV cells. Amorphous tungsten nitride films have shown much promise. Stability to annealing temperatures of 700, 800, and 550 C were achieved for overlays of silver, gold, and aluminum, respectively. The lower results for aluminum were not surprising because there is an eutectic that can form at a lower temperature. It seems that titanium and zirconium will remove the nitrogen from a tungsten nitride amorphous film and render it unstable. Other variables of research interest were substrate bias and base pressure during sputtering. Author

N86-29383*# Purdue Univ., West Lafayette, Ind.
MOD SILVER METALLIZATION: SCREEN PRINTING AND INK-JET PRINTING
R. W. Vest and G. M. Vest *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 443-456 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Basic material efforts have proven to be very successful. Adherent and conductive films were achieved. A silver neodecanoate/bismuth 2-ethylhexanoate mixture has given the best results in both single and double layer applications. Another effort is

continuing to examine the feasibility of applying metallo-organic deposition films by use of an ink jet printer. Direct line writing would result in a saving of process time and materials. So far, some well defined lines have been printed. Author

N86-29384*# Westinghouse Electric Corp., Pittsburgh, Pa.
PROCESS RESEARCH OF NON-Cz MATERIAL
Robert B. Campbell *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 457-466 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Efforts were aimed at achieving a simultaneous front and back junction. Lasers and other heat sources were tried. Successful results were gained by two different methods: laser and flash lamp. Polymer dopants were applied to both sides of dendritic web cells. Rapid heating and cooling avoided any cross contamination between two junctions after removal of the dendrites. Both methods required subsequent thermal annealing in an oven to produce maximum efficiency cells. Author

N86-29385# Westinghouse Electric Corp., Pittsburgh, Pa.
LASER-ASSISTED SOLAR-CELL METALLIZATION PROCESSING
A. Rohatgi, P. G. McMullin, and P. Rai-Choudhury *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 467-472 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Effort was directed toward metal patterning by use of argon laser and silver/bismuth metallo-organic deposition material. Excellent cell efficiencies were seen along with good ohmic contact and adhesion. Line widths down to .002 in were achieved. The only remaining process drawback is line thickness. At present, a secondary electroplating process step is required to obtain sufficient conductivity. Author

N86-29386# Superwave Technology, Inc., Santa Clara, Calif.
MICROWAVE-ENHANCED THIN-FILM DEPOSITION
S. Chitre *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 473-475 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Microwave enhanced plasma deposition experiments are reported. Advantages foreseen for use of microwaves are: higher electron plasma density by about 4 orders of magnitude, long species lifetime to allow separation of reactor and plasma generation, more control of deposition kinetics with less substrate damage, controlled film gradients or doping, lower power requirements, and lower reactive gas consumption. The feasibility of this process was demonstrated by the formation of silicon and silicon nitride films. Author

N86-29387*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
LIFE-CYCLE COSTS OF HIGH-PERFORMANCE CELLS
Ron Daniel, Dale Burger, and Leonard Reiter *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 477-483 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

A life cycle cost analysis of high efficiency cells was presented. Although high efficiency cells produce more power, they also cost more to make and are more susceptible to array hot-spot heating. Three different computer analysis programs were used: SAMICS (solar array manufacturing industry costing standards), PVARRAY (an array failure mode/degradation simulator), and LCP (lifetime cost and performance). The high efficiency cell modules were found to be more economical in this study, but parallel redundancy is recommended. Author

N86-29388*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SAMICS ON THE IBM PC
R. Chamberlain *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 485-487 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

An updated version of the Solar Array Manufacturing Industry Costing Standards (SAMICS) was presented. This version will run on the IBM PC-XT or compatibles, and embodies user friendly input screens and numerous help options. Use of this microcomputer version will still produce the old main frame direct cost driven analysis, although at some cost in turnaround time. A typical simulation will take about 4 hours. The program allows for unattended report printout. Also available is the IBM PC (or compatibles) version of the Improved Price Estimation Guidelines (IPEG). This program allows rapid analysis of process variables using SAMICS-generated coefficients. Author

N86-29389*# Springborn Labs., Inc., Enfield, Conn.
ENCAPSULATION PROCESSING AND MANUFACTURING YIELD ANALYSIS
P. Willis *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 489-500 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Evaluation of the ethyl vinyl acetate (EVA) encapsulation system is presented. This work is part of the materials baseline needed to demonstrate a 30 year module lifetime capability. Process and compound variables are both being studied along with various module materials. Results have shown that EVA should be stored rolled up, and enclosed in a plastic bag to retard loss of peroxide curing agents. The TBEC curing agent has superior shelf life and processing than the earlier Lupersol-101 curing agent. Analytical methods were developed to test for peroxide content, and experimental methodologies were formalized. Author

N86-29390# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
ADVANCED SILICON SHEET
Anthony Briglio, Jr. *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 501-502 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The session chairman's overview of ten presentations made covering research on silicon-shaped sheet technology is presented. E.R.

N86-29391*# Mobil Tyco Solar Energy Corp., Waltham, Mass.
SILICON RIBBON STRESS/STRAIN WORKSHOP
M. H. Leipold *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 503-505 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Highlights of the Flat Plate Solar Array Project sponsored Silicon Ribbon Stress/Strain Workshop that was held 23 to 24 January 1985 are reported. The presentations and discussions were aimed at acquiring a generic understanding of the sources of stress, deformation, and structural characteristics occurring during the growth of silicon ribbon. Author

N86-29392*# Westinghouse Electric Corp., Pittsburgh, Pa.
ADVANCED DENDRITIC WEB GROWTH DEVELOPMENT
R. H. Hopkins *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 507-525 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

A program to develop the technology of the silicon dendritic web ribbon growth process is examined. The effort is being concentrated on the area rate and quality requirements necessary to meet the JPL/DOE goals for terrestrial PV applications. Closed loop web growth system development and stress reduction for high area rate growth is considered. Author

N86-29393*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DEFECT CHARACTERIZATION OF SILICON DENDRITIC WEB

RIBBONS
Li-Jen Cheng *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 527-535 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Progress made in the study of defect characterization of silicon dendritic web ribbon is presented. Chemical etching is used combined with optical microscopy, as well as the electron beam induced current (EBIC) technique. Thermal annealing effect on carrier lifetime is examined. Author

N86-29394*# Cornell Univ., Ithaca, N.Y.
ELECTRICAL, STRUCTURAL, AND CHEMICAL CHARACTERIZATION OF SILICON SHEET MATERIALS
D. G. Ast and S. L. Hyland *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 537-542 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Progress on the electrical, structural, and chemical characterization of silicon sheet material is reported. In the study on high temperature deformation of dendritic web ribbon, experimental creep tests were performed in four point bending under constant load conditions, and unusual behavior was observed. Also, measurements of oxygen content in web ribbon were made. Two conclusions reached are creep behavior of web which is very different from any seen for single crystal silicon and oxygen level in web silicon which is near the saturation level at the melting point of silicon. Author

N86-29395*# Kentucky Univ., Lexington.
ANALYSIS OF SILICON STRESS/STRAIN RELATIONSHIPS
O. Dillon *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 543-563 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

In the study of stress-strain relationships in silicon ribbon, numerous solutions were calculated for stresses, strain rates, and dislocation densities through the use of the Sumino model. It was concluded that many cases of failure of computer solutions to converge are analytical manifestations of shear bands (Luder's band) observed in experiments. Author

N86-29396*# Mobil Tyco Solar Energy Corp., Waltham, Mass.
STRESS STUDIES IN EDGE-DEFINED FILM-FED GROWTH OF SILICON RIBBONS
J. Kalejs *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 565-573 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Stress and efficiency studies on sheet silicon are reported. It was found that the bulk diffusion length of stressed float zone and Czochralski silicon is limited by point defect recombination to about 20 micrometers in dislocation free regions after high temperature heat treatment and stress application. If in-diffusion by iron occurs, dislocations, carbon and oxygen, do not produce significant gettering with annealing. Further work ideas are suggested. Author

N86-29397*# Massachusetts Inst. of Tech., Cambridge.
ANALYSIS OF HIGH-SPEED GROWTH OF SILICON SHEET IN INCLINED-MENISCUS CONFIGURATION
P. D. Thomas and R. A. Brown *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 575-585 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The study of high speed growth of silicon sheet in inclined-meniscus configurations is discussed. It was concluded that the maximum growth rates in vertical and inclined growth are set by thermal-capillary limits. Also, the melt/crystal interface was determined to be flat. And, vertical growth is qualitatively modelled by one dimensional heat transfer. Author

N86-29398*# Mobil Tyco Solar Energy Corp., Waltham, Mass.
HIGH-PURITY SILICON CRYSTAL GROWTH INVESTIGATIONS
T. F. Ciszek, J. L. Hurd, and T. Schuyler *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 587-600 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The study of silicon sheet material requirements for high efficiency solar cells is reported. Research continued on obtaining long lifetime single crystal float zone silicon and on understanding and reducing the mechanisms that limit the achievement of long lifetimes. The mechanisms studied are impurities, thermal history, point defects, and surface effect. The lifetime related crystallographic defects are characterized by X-ray topography and electron beam induced current. Author

N86-29399*# Illinois Univ., Chicago.
SILICON SHEET SURFACE STUDIES
S. Danyluk *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 601-619 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Results of the program are presented on developing an understanding of the basic mechanisms of abrasion and wear of silicon and on the nondestructive measurement of residual stresses in sheet silicon. Experiments were conducted at various temperatures and in the presence of various fluids. In abrasive wear, it was shown that dislocations, microtwins, and cracks are generated beneath the contact surface. Residual stresses in ribbon by the edge defined film growth process were measured by use of a shadow moire interferometry technique. Author

N86-29400*# Spire Corp., Bedford, Mass.
HIGH-EFFICIENCY MODULE DESIGN
M. B. Spitzer *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 623-632 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

Progress on the development of a high efficiency module is described. The effort includes development of high efficiency cells using crystalline silicon wafers from float zone silicon. Module-size cells, 53 sq cm in area, were fabricated with efficiency of 18%. Operating temperature reduction is also studied. Author

N86-29401*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
MODULE FLAMMABILITY RESEARCH
R. S. Sugimura and D. H. Otth *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 633-636 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

New materials were developed which show promise of fabricating modules that can pass the Underwriter Laboratories Class A burning brand test for fire ratable solar cell modules. It is concluded that fire resistant module design require special high temperature materials and constructions to achieve Class B and Class A ratings. Also, synergisms exist between back surface materials and module configuration. Author

N86-29402*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
DEVELOPMENT OF DESIGN CRITERIA AND A QUALIFICATION TEST FOR BYPASS DIODES
D. H. Otth *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 637-640 (For primary document see N86-29347 20-44)
Avail: NTIS HC A99/MF E03 CSCL 10A

The development of a qualification test for modules bypass diodes is reviewed. Diode junction temperature is measured, indirectly, under laboratory ambient conditions, and extrapolated to field conditions. Criteria are given for diode reliability. Author

N86-29403*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

DEVELOPMENT OF AM 1.5 GLOBAL MEASUREMENT PROCEDURES AND INTERNATIONAL CELL MEASUREMENT ROUND ROBIN

R. Mueller *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 641-648 (For primary document see N86-29347 20-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

The development of the capability for measurement under global irradiance spectral distribution is reported. The airmass 1.5 global measurement procedure is given. Also given is the procedure and justification for using the large area pulsed solar simulator (LAPSS). The status of the international round robin of reference cell measurements managed by the Commission of European Communities (CEC) is described. Author

N86-29404*# Clemson Univ., S.C.

AMORPHOUS-SILICON CELL RELIABILITY TESTING

J. W. Lathrop *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 649-658 (For primary document see N86-29347 20-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

The work on reliability testing of solar cells is discussed. Results are given on initial temperature and humidity tests of amorphous silicon devices. Calibration and measurement procedures for amorphous and crystalline cells are given. Temperature stress levels are diagrammed. Author

N86-29405*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

PHOTOCURRENT IMAGES OF AMORPHOUS-SILICON SOLAR-CELL MODULES

Q. Kim, A. Shumka, and J. Trask *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 659-672 (For primary document see N86-29347 20-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

Results obtained in applying the unique characteristics of the solar cell laser scanner to investigate the defects and quality of amorphous silicon cells are presented. It is concluded that solar cell laser scanners can be effectively used to nondestructively test not only active defects but also the cell quality and integrity of electrical contacts. Author

N86-29406*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

AMORPHOUS-SILICON MODULE HOT-SPOT TESTING

C. C. Gonzalez *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 673-684 (For primary document see N86-29347 20-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

Hot spot heating occurs when cell short-circuit current is lower than string operating current. Amorphous cell hot spot are tested to develop the techniques required for performing reverse bias testing of amorphous cells. Also, to quantify the response of amorphous cells to reverse biasing. Guidelines are developed from testing for reducing hot spot susceptibility of amorphous modules and to develop a qualification test for hot spot testing of amorphous modules. It is concluded that amorphous cells undergo hot spot heating similarly to crystalline cells. Comparison of results obtained with submodules versus actual modules indicate heating levels lower in actual modules. Module design must address hot spot testing and hot spot qualification test conducted on modules showed no instabilities and minor cell erosion. E.R.

N86-29407*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.

PVARRAY: A SOFTWARE TOOL FOR PHOTOVOLTAIC ARRAY DESIGN

Dale R. Burger *In its* Proceedings of the 25th Project Integration Meeting Jun. 1985 p 685-690 (For primary document see N86-29347 20-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

The application of PVARRAY, a software program for design of photovoltaic arrays are described. Results of sample parametric studies on array configurations are presented. It is concluded that PVARRAY could simulate a variety of configurations. Author

N86-29408*# Westinghouse Electric Corp., Pittsburgh, Pa.

DENDRITIC WEB-TYPE SOLAR CELL MINI-MODULES

R. B. Campbell *In* JPL, Pasadena, Calif. Proceedings of the 25th Project Integration Meeting Jun. 1985 p 691-692 (For primary document see N86-29347 20-44)

Avail: NTIS HC A99/MF E03 CSCL 10A

Twenty-five minimodules composed of dendritic web solar cells with nominal glass size of 12 by 40 cm were provided for study. The modules were identical with respect to design, materials, and manufacturing and assembly processes to full scale modules. The modules were also electrically functional. These minimodules were fabricated to provide test vehicle for environmental testing and to assess reliability of process and design procedures. The module design and performance are outlined. E.R.

N86-29409*# Akron Univ., Ohio. Dept. of Chemical Engineering.

THEORETICAL AND EXPERIMENTAL FLOW CELL STUDIES OF A HYDROGEN-BROMINE FUEL CELL, PART 1 M.S. Thesis. Final Report

Robert F. Savinell and Sharon D. Fritts 1 Mar. 1986 214 p (Grant NAG3-500)

(NASA-CR-177165; NAS 1.26:177165) Avail: NTIS HC A10/MF A01 CSCL 10B

There is increasing interest in hydrogen-bromine fuel cells as both primary and regenerative energy storage systems. One promising design for a hydrogen-bromine fuel cell is a negative half cell having only a gas phase, which is separated by a cationic exchange membrane from a positive half cell having an aqueous electrolyte. The hydrogen gas and the aqueous bromide solution are stored external to the cell. In order to calculate the energy storage capacity and to predict and assess the performance of a single cell, the open circuit potential (OCV) must be estimated for different states of change, under various conditions. Theoretical expressions were derived to estimate the OCV of a hydrogen-bromine fuel cell. In these expressions temperature, hydrogen pressure, and bromine and hydrobromic acid concentrations were taken into consideration. Also included are the effects of the Nafion membrance separator and the various bromide complex species. Activity coefficients were taken into account in one of the expressions. The sensitivity of these parameters on the calculated OCV was studied. Author

N86-29410# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

LONG-TERM POWER SYSTEM SIMULATION FOR REAL-TIME TRAINING WITH A REDUCED SIZE PROGRAM

Marco AlfredoDiLascio Apr. 1986 8 p Presented at the IEEE/Power Engineering Society Summer Meeting, Mexico City, Mexico, 20-25 Jul. 1986 Submitted for publication

(INPE-3859-PRE/923) Avail: NTIS HC A02/MF A01

The results of a reduced size computer program for long term power systems simulation are discussed. Detailed models of a hydro, a coal-fired, and a pressurized water reactor (PWR) generation plant are included. Typical data taken from operating records were used. Since the simulation runs faster than real-time, the program can be used for power system simulator operator training. Author

N86-29411*# United Technologies Corp., South Windsor, Conn. Power Systems Div.

ADVANCED ON-SITE POWER PLANT DEVELOPMENT TECHNOLOGY PROGRAM Annual Report, 1984

Fred S. Kemp Feb. 1985 276 p

(Contracts DEN3-289; DE-AI21-80ET-17088)

(NASA-CR-175007; NAS 1.26:175007; FCR-6848;

DOE/NASA/0389-3) Avail: NTIS HC A13/MF A01 CSCL 10B

A 30-cell stack was tested for 7200 hours. At 6000 hours the stack was successfully refilled with acid with no loss of performance. A second stack containing the advanced Configuration B

cell package was fabricated and assembled for testing in 1985. A 200-kW brassboard inverter was successfully evaluated, verifying the design of the two-bridge ASCR circuit design. A fuel processing catalyst train was tested for 2000 hours verifying the catalyst for use in a 200-kW development reformer. The development reformer was fabricated for evaluation in 1985. The initial test plan was prepared for a 200-kW verification test article. Author

N86-29412*# National Aeronautics and Space Administration, Washington, D.C.
CURRENT DEVELOPMENTS IN ELECTROCHEMICAL STORAGE SYSTEMS FOR SATELLITES
G. Gutmann Jul. 1986 22 p Transl. into ENGLISH from Zeitschrift fuer Flugwissenschaften und Weltraumforschung (West Germany), v. 9, Jul. - Aug. 1985 p 229-235 Original language document was announced in IAA as A86-11760 Transl. by Kanner (Leo) Associates, Redwood City, Calif. Original document was prepared by Deutsche Automobilgesellschaft
(Contract NASw-4005)
(NASA-TM-88471; NAS 1.15:88471; ISSN-0342-068X) Avail: NTIS HC A02/MF A01 CSCL 10C

The need for batteries with greater power capacity and service life for power satellites is examined. The Ni/Cd and Ni/H batteries now being used must be upgraded to meet advanced space requirements. Improvements in power capacity, service life, and cycle count for various satellites in LEO and GEO orbits are discussed. The Ni/Cd and Ni/H cell reactions are explained, and the solubility and volume changes for various charged and uncharged masses are described. A chart of the energy content and cycle count for various cell systems is presented, and the factors which cause aging and failure in the Ni/Cd and Ni/H cell systems are discussed. The advantages of the Ni/H battery are given and the need for more developed electrochemical storage systems because of an increase in the mass of satellites is explained. The requirements for space batteries and the work currently done by NASA and West Germany on advanced batteries are discussed. Author

N86-29413# Texas Technological Coll., Lubbock. Dept. of Mathematics.
SOLAVG: RADIALLY AVERAGED OPTICAL POWER RATIO CALCULATIONS. THE CROSBYTON SOLAR POWER PROJECT
W. T. Ford and R. M. Anderson 15 Aug. 1985 155 p
(Contract DE-AC04-83AL-21557)
(DE86-004960; DOE/AL-21557/T5) Avail: NTIS HC A08/MF A01

Several analytical and computational models have been developed during the course of the Crosbyton Solar Power Project (CSPP) to aid design and prediction of performance for the solar bowl technology. The ROSA (Ratio of Solid Angles) code has been previously reported. This report deals with the SOLAVG (Solar Average) code. The SOLAVG code produces output to be used as input to the WATER1 code which is being reported elsewhere. The SOLAVG code includes much of the ROSA code to obtain concentrations to be averaged around the receiver using the Romberg algorithm. These averages vary with distance along the receiver. The WATER1 code uses these averaged solar concentrations to compute thermodynamic quantities along the length of the receiver. Sixteen examples of output from SOLAVG are listed and plotted in this report. An example of the output from WATER1 based on input from SOLAVG is given as a complete print, and three examples of such output are plotted. ROSA, SOLAVG, and WATER1 are all available on disks which were recorded on an IBM-XT. All three codes compile using Microsoft FORTRAN (c) to produce operable object codes. All listed and plotted results in this report are also available on disks upon request. DOE

N86-29414# Lawrence Livermore National Lab., Calif.
ENERGY AND TECHNOLOGY REVIEW
Nov. 1985 42 p
(Contract W-7405-eng-48)
(DE86-005295; UCRL-52000-85-11) Avail: NTIS HC A03/MF A01

This issue is devoted entirely to X-ray laser technology. It includes information on theory, LASNEX and XRASER modeling codes, experiments, the Novette laser system, X-ray lasing targets, time-resolving X-ray spectrometers capable of subnanosecond resolution for diagnostics, and future directions in X-ray laser physics. DOE

N86-29415# Gould, Inc., Rolling Meadows, Ill. Research Center.
FUNDAMENTAL THERMAL MANAGEMENT ASPECTS OF THE LITHIUM METAL SULFIDE BATTERY Final Report
D. M. Chen and H. F. Gibbard Jul. 1985 115 p
(Contract DE-AC03-76SF-00098)
(DE86-005871; LBL-20026) Avail: NTIS HC A06/MF A01

Objectives of this project were the determination of heat generation rates and measurement of temperature distributions of lithium-metal sulfide batteries. The experimental methods used were calorimetry, emf and polarization measurements, and direct measurements of internal cell temperature. DOE

N86-29416# Sandia National Labs., Albuquerque, N. Mex.
OXIDATION/SULFIDATION OF MATERIAL CANDIDATES FOR DISTRIBUTED SOLAR RECEIVER THERMOCHEMICAL TRANSPORT PROGRAM
L. J. Weirick 1986 16 p Presented at the ASME Solar Energy Division Conference, Anaheim, Calif., 14 Apr. 1986
(Contract DE-AC04-76DP-00789)
(DE86-005633; SAND-85-1657C; CONF-860406-6) Avail: NTIS HC A02/MF A01

Metals for potential use in the dissociator and the synthesizer reactors of a distributed solar receiver thermochemical transport loop utilizing SO3/SO2/O2 molecular chemistry includes stainless steels and iron-base, nickel-base and cobalt-base superalloys. We tested these alloys in SO2/O2 mixtures and SO3 gas at 500(0)C and 900(0)C, respectively, for times of up to four weeks. Weight gain measurements were used to determine the oxidation/sulfidation kinetics and electron microprobe analysis was used to measure penetration of oxygen and sulfur into the metal and to identify the formation of internal oxides and sulfides. Results of these tests showed that the most promising candidates are those containing sufficient quantities of both aluminum and chromium alloying additions to be alumina and chromia formers, such as Kanthal A-1, Nimonic 105 and Cabot 214. DOE

N86-29417# Sandia National Labs., Albuquerque, N. Mex.
DOE INNOVATIVE CONCENTRATOR PROJECT
T. R. Mancini 1986 12 p Presented at the ASME Solar Energy Division Conference, Anaheim, Calif., 14 Apr. 1986
(Contract DE-AC04-76DP-00789)
(DE86-000205; SAND-85-1658C; CONF-860406-3) Avail: NTIS HC A02/MF A01

The purpose of the Department of Energy Solar Thermal Program Concentrator Task is to develop efficient, low cost methods of concentrating solar energy as a high temperature thermal source for process heat applications and for electrical power generation. The annual efficiency and cost of point-focus concentrators are presently about 62% and $650/M(2), respectively. The long-term program goals are to produce point-focus concentrators which are 78% efficient for a cost of $140/M(2). DOE

N86-29418# Pacific Northwest Lab., Richland, Wash.
PRIMER OF TURBULENCE IN THE WIND TURBINE LAYER
J. R. Connell Aug. 1985 11 p Presented at the WINDPOWER '85, San Francisco, Calif., 27 Aug. 1985
(Contract DE-AC06-76RL-01830)
(DE86-001643; PNL-SA-13102; CONF-850834-4) Avail: NTIS HC A02/MF A01

Some wind turbine fatigue problems are caused by the turbulent wind, and there is an engineering need to understand both qualitatively and quantitatively the characteristics of the wind that

are causing untimely damage to wind turbine components. To meet this need, the paper describes, in simple terms, turbulent motion: where it is generated and how it changes with differences in terrain, height above the ground, meteorological conditions, time, and distance from its source. The character of the turbulent wind as it is experienced at points on a rotating rotor blade is also examined. Some ways in which turbulent wind interacts with a turbine rotor to produce fluctuating forces and stresses on turbine components are identified. Stresses calculated or otherwise estimated from recent more realistic turbulence information can be much more severe than if the new turbulence information is not used in the analysis of turbine response. The paper concludes with examples of several computational methods and several measurement methods of modeling the turbulent wind that loads and stresses turbine rotors. DOE

N86-29419# Meridian Corp., Falls Church, Va.
PHOTOVOLTAIC RESEARCH OPPORTUNITIES Final Report
B. Macaleer, J. Bowers, and B. Hurlbut 19 Nov. 1985 134 p
(Contract DE-AC01-84ER-30064)
(DE86-007417; DOE/ER-30064/T1) Avail: NTIS HC A07/MF A01

The purpose of this study is to identify opportunities for photovoltaic (PV) research projects to capitalize on related but non-PV research. The study is performed under the assumption that a considerable body of ongoing semiconductor research in non-PV areas could be of value to its PV Program and the PV community in general. Research related to III-V compounds, thin films, and crystalline silicon materials is included. Research that is known to be PV-related or sponsored by DOE was excluded from consideration. The study resulted in 11 recommendations (research areas) and a subset of 58 specific research projects. In addition, over 75 non-PV research managers in the semiconductor field are identified as potential sources of ideas which could benefit photovoltaics. DOE

N86-29420# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
EVALUATION OF TWO PERFORMANCE PREDICTION METHODS FOR HORIZONTAL-AXIS WIND TURBINES BY COMPARISON WITH EXPERIMENTAL RESULTS
J. A. vanEgmond 1985 39 p Sponsored by National Research Program on Wind Energy (NOW II)
(Contract ECN-4401-3.4)
(NLR-TR-85028-L; ESA-86-97403) Avail: NTIS HC A03/MF A01

A computer program based on Glauert's blade element theory and a program based on a rotating lifting line theory with nonlinear vortex wake modeling were compared with experimental results for two horizontal-axis wind turbines. In spite of the higher level of sophistication of the lifting line/vortex wake model, the quality of the predicted characteristics of both methods is equal. The blade element theory is far less expensive in computing costs than the rotating lifting line theory. Large differences between theory and experiment can only be explained partly from uncertainties in the aerodynamic characteristics of the basic airfoil sections. For the two different turbine configurations considered, no systematic differences between theory and experiment are found, raising questions about the reliability of the measured data. The rotating lifting line theory suggests that a slightly different optimum blade geometry with wider tip chord than predicted by blade element theory might lead to a performance increase. ESA

45 ENVIRONMENT POLLUTION

Includes air, noise, thermal and water pollution; environment monitoring; and contamination control.

N86-29421*# San Francisco State Univ., Calif. Frederick Burk Foundation.
BIOLOGICALLY PRODUCED VOLATILE COMPOUNDS: N1O EMISSIONS FROM SOILS Final Scientific Report, 1 Sep. 1984 - 30 Aug. 1985
A. Banin Sep. 1985 12 p
(Contract NCC2-321)
(NASA-CR-177111; NAS 1.26:177111) Avail: NTIS HC A02/MF A01 CSCL 13B

Tropospheric nitrous concentration has increased by 0.2 0.4% per year over the period 1975 to 1982, amounting to net addition to the atmosphere of 2.8 - 5.6 Tg N2O-N per year. This perturbation, if continued into the future, will affect stratospheric chemical cycles, and the thermal balance of the Earth. In turn it will have direct and indirect global effects on the biosphere. Though the budget and cycles of N2O on Earth are not yet fully resolved, accumulating information and recent modelling efforts permit a more complete evaluation and better definition of gaps in our knowledge. Author

N86-29422*# National Aeronautics and Space Administration, Washington, D.C.
TREATMENT FOR HYDRAZINE-CONTAINING WASTE WATER SOLUTION
N. Yade Aug. 1986 12 p Transl. into ENGLISH of Japanese Patent No. 54-23071 (21 Feb. 1979) p 383-386 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4004)
(NASA-TM-88472; NAS 1.15:88472) Avail: NTIS HC A02/MF A01 CSCL 13B

The treatment for waste solutions containing hydrazine is presented. The invention attempts oxidation and decomposition of hydrazine in waste water in a simple and effective processing. The method adds activated charcoal to waste solutions containing hydrazine while maintaining a pH value higher than 8, and adding iron salts if necessary. Then, the solution is aerated.
Author

N86-29423# Rhode Island Univ., Narragansett. Graduate School of Oceanography.
ELEMENT TRACERS OF SOURCE REGIONS OF CONTAMINANTS IN PRECIPITATION Quarterly Report
K. A. Rahn 15 Jan. 1986 22 p
(Contract DE-FG22-84PC-71253)
(DE86-005405; DOE/PC-71253/4; QR-4) Avail: NTIS HC A02/MF A01

Activity was continued on the following projects: each rain at Narragansett was collected and analyzed with its corresponding aerosol samples. The rain-sampling procedure was improved. Analytical blanks associated with the plastic bags were reduced by large factors. The precipitation and aerosol data are being examined for systematic features. In addition we have begun an informal cooperative effort to apply our analytical technique to measuring elemental abundances in several waterways of Rhode Island, in conjunction with Rhode island College. We are laying more concrete plans to expand our study of precipitation and aerosol in China. Each of these topics is discussed in more detail. DOE

N86-29424# Department of Energy, Washington, D. C. Carbon Dioxide Research Div.
DETECTING THE CLIMATIC EFFECTS OF INCREASING CARBON DIOXIDE
M. C. MacCracken, ed. and F. M. Luther, ed. Dec. 1985 221 p
(DE86-006223; DOE/ER-0235) Avail: NTIS HC A12/MF A01

This report documents what is known about detecting the CO2-induced changes in climate, and describes the uncertainties and unknowns associated with this monitoring and analysis effort. The various approaches for detecting CO2-induced climate changes are discussed first, followed by a review of applications of these strategies to the various climatic variables that are expected to be changing. Recommendations are presented for research and analysis activities. Separate abstracts have been prepared for the individual papers. DOE

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N86-29425*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EL NINO AND OUTGOING LONGWAVE RADIATION: AN ATLAS OF NIMBUS-7 EARTH RADIATION BUDGET OBSERVATIONS
H. Lee Kyle (Research and Data Systems, Inc., Lanham, Md.), Philip E. Ardanuy, and Richard R. Hucek Apr. 1986 184 p
(Contract NAS5-27728)
(NASA-RP-1163; NAS 1.61:1163; Rept-85B0565) Avail: NTIS HC A05/MF A01 CSCL 04A

Five years of broadband Earth Radiation Budget (ERB) measurements taken by the Nimbus-7 ERB experiment have been archived. This five year period included the 1982 to 1983 El Nino/Southern Oscillation event, which reached its peak in January 1983 (near the beginning of the fifth data year). An outgoing longwave radiation subset of the data, for the period June 1980 to October 1983, was processed to enhance spatial resolution. This atlas contains the analyses of the resultant fields. In addition, a set of anomaly maps, based on a definition of pre-El Nino climatology, is included. Together, these two sets of maps provide the first broadband glimpse of the terrestrial outgoing longwave radiation response to the El Nino event. Author

N86-29426*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTRAPLATE DEFORMATION DUE TO CONTINENTAL COLLISIONS: A NUMERICAL STUDY OF DEFORMATION IN A THIN VISCOUS SHEET
Steven C. Cohen and Richard C. Morgan Oct. 1985 27 p
(NASA-TM-86235; 86B0019; NAS 1.15:86235) Avail: NTIS HC A03/MF A01 CSCL 08G

Continental collisions can result in the transmission of stress from the boundary between tectonic plates into the plate interiors. Extensive crustal deformations characterized by both horizontal and vertical crustal movements have occurred as a consequence of collisions in both contemporary and ancient tectonic environments. These deformations have been analyzed by a number of observers who in recent years have begun to propose various geological and numerical models of the collision processes. One of the more successful models involves the penetration of a rigid punch (one plate) into a deformable sheet (another plate). For example, this model has been used by Tapponier and Molnar (1977), Vilotte et al. (1982), and others as an aid in understanding the tectonics of the India-Eurasia collision. In this paper we examine in detail some of the features of this model as first formulated by England and coworkers (1982, 1983, 1985; Houseman and England, 1985). Using a linear viscous flow law for most of our calculations, we compute the magnitude and rate of change of crustal thickness, the velocity of various mass points, strain rates and their principal axes, modes of deformation, areal changes, and stress. Particular attention is paid to the role of lateral boundary conditions. In general a free lateral boundary reduces the magnitude of changes in crustal thickening (compared to a fixed lateral boundary) by allowing material to more readily escape the advancing punch. The shearing that occurs diagonally in front of the advancing punch terminates in compression or extension depending on whether the lateral boundary is fixed or free to move. When the ratio for the diameter of the punch to that of the viscous sheet exceeds about one-third, the deformation in front of the punch is insensitive to the specific choice of lateral boundary conditions. Although gravitational effects can then reduce the rate of compression and crustal thickening in a plate deforming by nonlinear viscous flow, this effect is minor for linear flow unless the viscosity is small and/or the topographic relief substantial. the leading point (center) of the punch. While many of the other observed qualitative deformation features are present for both linear and nonlinear flow laws, some change significantly. In particular, the variation in compression rate with distance from the punch is sensitive to the choice of rheological law. With a linear law, the axial distance from the middle of the punch to the point of local maximum compression is relatively invariant with time. This maximum occurs much farther from the punch than is predicted from recently published approximate analytical expressions. For a nonlinear law, the location of the maximum propagates away from the punch/sheet boundary. Author

N86-29427# Finnish Meteorological Inst., Helsinki.
THE STRUCTURE OF THE MARINE ATMOSPHERIC BOUNDARY LAYER: A REVIEW FROM THE POINT OF VIEW OF DIFFUSIVITY, TRANSPORT AND DEPOSITION PROCESSES
Sylvain M. Joffre Nov. 1985 120 p
(FMI-TR-29; ISBN-9051-697-220-9; ISSN-0355-1733) Avail: NTIS HC A06/MF A01

Through a review of the literature, the structure of the marine atmospheric boundary layer (MABL) was sketched for the mean flow with profiles of velocity, temperature, water vapor and trace species and for turbulence with profiles of variances, fluxes and eddy exchange coefficients. Results from the few field experiments available were compiled and compared if possible to theoretical or model predictions. It appears that mainly the slightly to strongly unstable types of MABL were studied but, e.g., the stably stratified case remains rather unknown observationally. This suggests priorities for future experimental efforts. Some climatological knowledge was gained through the analysis of a few years' data of averaged wintertime ocean weather ship observations for mean quantities. In conclusion, the MABL height seems to be, except for convective conditions, in the range of 400 to 800 m, but the often present capping cloud layer with its own independent vertical mixing obscures the interpretation of the profiles. Author

N86-29428*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
SAM 2 MEASUREMENTS OF THE POLAR STRATOSPHERIC AEROSOL, VOLUME 8 Report, Apr. - Oct. 1982
M. Patrick McCormick and David Brandl (Systems and Applied Sciences Corp., Hampton, Va.) Aug. 1986 80 p
(NASA-RP-1165; L-16106; NAS 1.61:1165) Avail: NTIS HC A05/MF A01 CSCL 04A

The Stratospheric Aerosol Measurement (SAM) 2 sensor aboard Nimbus 7 is providing extinction measurements of Antarctic and Arctic stratospheric aerosols with a vertical resolution of 1 km. Representative examples and weekly averages including corresponding temperature profiles provided by NOAA for the time and place of each SAM 2 measurement (Apr. 1982 - Oct. 1982) are presented. Contours of aerosol extinction as a function of altitude and longitude or time are plotted, and aerosol optical depths are calculated for each week. Typical values of aerosol extinction at 1.0 microns in the main stratospheric aerosol layer are approximately 4 to 6 times .0001/km at the beginning to 1 to 2 times .001/km at the end of the time period for the Antarctic region and approximately 1 to 3 times .001/km for the Arctic region throughout the time period. Stratospheric optical depths are about 0.002 to 0.009 for the Antarctic region and about 0.007 at the beginning to 0.024 at the end of the time period for the Arctic region. Polar stratospheric clouds were observed during the Antarctic winter, as expected. This report provides, in a ready-to-use format, a representative sample of the eighth 6 months of data to be used in atmospheric and climatic studies, Author

N86-29429# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
HIGH RESOLUTION MEASUREMENTS OF OH INFRARED AIRGLOW STRUCTURE Ph.D. Thesis
Parris C. Neal 1985 285 p
(AD-A166377; AFIT/CI/NR-86-26D) Avail: NTIS HC A13/MF A01 CSCL 04/1

Disturbances in the normally calm atmospheric airglow layer, which cause bright and dark band or stripes to appear, have been observed. These disturbances are attributed to gravity waves propagating through the atmosphere. An instrument capable of resolving the temporal, spatial, and spectral attributes of OH

infrared emissions was designed to gather quantitative data on airglow structure. An optically compensated interferometer spectrometer was chosen as the basic instrument to measure this phenomenon. Spatial data were obtained by matching the interferometer's high throughput to a unique optical system which includes a 50-cm diameter telescope. This Dall Kirkham telescope maintains the large throughput of the interferometer but narrows the instrument field of view to less than a degree. The spatial resolution of the system is 14 milliradians. A bright OH Meinel airglow structure event was recorded. The structures were measured at elevation angles near the horizon. Apparent wavelengths, periods, and phase velocities, of 24 + or - 1 km, 14 + or - 1 minutes, and 28 + or - 2 meters/second, respectively, were calculated for the recorded structure. GRA

N86-29430# Naval Research Lab., Washington, D. C.
CONVECTIVE STABILIZATION OF IONOSPHERIC PLASMA CLOUDS
J. F. Drake and J. D. Huba 19 Mar. 1986 47 p
(AD-A166431; NRL-MR-5722) Avail: NTIS HC A03/MF A01 CSCL 04/1

We derive a stability criteria for the large-scale structuring of ionospheric plasma clouds due to the E X B gradient drift instability. For the equilibrium we consider a cylindrical 2D waterbag cloud aligned along a uniform magnetic field that is polarized by a neutral wind. We perform a stability analysis that allows three dimensional perturbations (in r, theta, and z), and consider both local and global modes. We find that when the parallel wavenumber k sub z exceeds a threshold value, exponentially growing global eigenmodes form which are localized on the backside of the cloud. This is in contrast to the k sub z = 0 limit in which there are no exponential solutions. As k sub z is increased further, the unstable modes localize at a finite angle away from the backside; at a point where the diamagnetic propagation velocity (V sub d) balances the convective flow velocity of the background plasma around the cloud (V sub b). We find that the E X B gradient drift instability is stable when V sub d - V sub b so that the cloud is no longer susceptible to large-scale structuring. GRA

N86-29431# Naval Ocean Systems Center, San Diego, Calif.
LIDAR MEASUREMENTS INDICATING ATMOSPHERIC INHOMOGENEITIES Final Report, 1 Jul. - 31 Oct. 1985
Merle H. Paulson 1 Feb. 1986 15 p
(AD-A166440; NOSC/TD-867) Avail: NTIS HC A02/MF A01 CSCL 04/1

Various methods for interpreting lidar data require that the atmospheric aerosol distributions be homogeneous in the horizontal direction. While many workers in aerosol extinction and lidar backscatter report that rarely, if ever, is the atmosphere sufficiently homogeneous horizontally for this to be a good assumption, most of them make the assumption anyway, or select cases where they say that, for their purposes, it is sufficiently homogeneous horizontally. This document considers some of the findings reported in the literature and presents some examples of lidar data obtained off the bluff at Point Loma in San Diego, California, showing pronounced aerosol inhomogeneities in the horizontal. It is concluded that while the lidar may be useful for studying atmospheric aerosols when used in conjunction with other meteorological measurements, it probably cannot be used as a stand-alone device for determining visibility. GRA

N86-29432*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
BIDIRECTIONAL ELECTRON ANISOTROPIES IN THE DISTANT TAIL: ISEE-3 OBSERVATIONS OF POLAR RAIN
D. N. Baker, S. J. Bame, W. C. Feldman, J. T. Gosling, R. D. Zwickl, J. A. Slavin, and E. J. Smith 1985 20 p Presented at the Chapman Conference on Magnetotail Physics, Laurel, Md., 28 Oct. 1985 Prepared in cooperation with Los Alamos National Lab., Calif.
(Contract W-7405-eng-36)
(DE86-004737; LA-UR-85-4310; CONF-8510254-1) Avail: NTIS HC A02/MF A01

A detailed observational treatment of bidirectional electrons (50 approx. 500 eV) in the distant magnetotail (or greater than or equal to 100 R sub E) is presented. It is found that electrons in this energy range commonly exhibit strong, field-aligned anisotropies in the tail lobes. Because of large tail motions, the ISEE-3 data provide extensive sampling of both the north and south lobes in rapid succession, demonstrating directly the strong asymmetries that exist between the north and south lobes at any one time. The bidirectional fluxes are found to occur predominantly in the lobe directly connected to the sunward IMF in the open magnetosphere model (north lobe for away sectors and south lobe for toward sectors). Electron anisotropy and magnetic field data are presented which show the transition from unidirectional (sheath) electron populations to bidirectional (lobe) populations. Taken together, the present evidence suggests that the bidirectional electrons that we observe in the distant tail are closely related to the polar rain electrons observed previously at lower altitudes. Furthermore, these data provide strong evidence that the distant tail is comprised largely of open magnetic field lines in contra distinction to some recently advanced models. DOE

N86-29433# Los Alamos National Lab., N. Mex.
CONSOLIDATION AND SHEAR FAILURE LEADING TO SUBSIDENCE AND SETTLEMENT, PART 1
W. V. Abeele Nov. 1985 44 p
(Contract W-7405-eng-36)
(DE86-005880; LA-10261-MS-Pt-1) Avail: NTIS HC A03/MF A01

Subsidence and settlement are phenomena that are much more destructive than generally thought. In shallow land burials they may lead to cracking of the overburden and eventual exposure and escape of waste material. The primary causes are consolidation and cave-ins. Laboratory studies performed at Los Alamos permit us to predict settlement caused by consolidation or natural compaction of the crushed tuff overburden. We have also investigated the shear failure characteristics of crushed tuff that may lead to subsidence. Examples of expected settlement and subsidence are calculated based on the known geotechnical characteristics of crushed tuff. The same thing is done for bontonite/tuff mixes because some field experiments were performed using this additive (bentonite) to reduce the hydraulic conductivity of the crushed tuff. Remedial actions, i.e., means to limit the amount of settlement, are discussed. Finally, we briefly comment on our current field experiment, which studies the influence of subsidence on layered systems in general and on biobarriers in particular. DOE

N86-29434# New Mexico State Univ., Las Cruces. Dept. of Mechanical Engineering.
ATMOSPHERIC ATTENUATION OF SOLAR RADIATION AND CALIBRATION OF MULTIPLE WAVELENGTH SUN PHOTOMETERS
D. M. Price, G. P. Mulholland, L. K. Matthews, and D. L. King (Sandia National Labs., Albuquerque, N. Mex.) Jan. 1986 106 p Prepared in cooperation with Sandia National Labs., Albuquerque, NM.
(Contract DE-AC04-76DP-00789)
(DE86-006546; SAND-85-7010) Avail: NTIS HC A06/MF A01

The activities detailed in this report include a review of the literature pertaining to the atmospheric attenuation of solar radiation, the maintenance and calibration of Volz and Sandia designed sun photometers, a comparison of the SOLTRAN5 and LOW-TRAN6 spectral irradiance models, an evaluation of the Li-Cor LI-1800 spectral radiometer, and a comparison between Li-Cor measurements of solar spectral irradiance and the modeled results from LOWTRAN6. Suggestions for the improvement of the sun photometers and the Li-Cor are also given. DOE

N86-29435# Los Alamos National Lab., N. Mex.
APPLICATION OF SUPERCOMPUTERS TO 3-D MANTLE CONVECTION
J. R. Baumgardner 1986 44 p Presented at the NATO Advanced Study Institute on the Physics of Planets: Their Origin, Evolution and Structure, Los Alamos, N. Mex., 1 May 1984

(Contract W-7405-eng-36)
(DE86-006004; LA-UR-86-6; CONF-8405385-1) Avail: NTIS HC A03/MF A01

Current generation vector machines are providing for the first time the computing power needed to treat planetary mantle convection in a fully three-dimensional fashion. A numerical technique known as multigrid has been implemented in spherical geometry using a hierarchy of meshes constructed from the regular icosahedron to yield a highly efficient three-dimensional compressible Eulerian finite element hydrodynamics formulation. The paper describes the numerical method and presents convection solutions for the mantles of both the Earth and the Moon. In the case of the Earth, the convection pattern is characterized by upwelling in narrow circular plumes originating at the core-mantle boundary and by downwelling in sheets or slabs derived from the cold upper boundary layer. The preferred number of plumes appears to be on the order of six or seven. For the Moon, the numerical results indicate that development of a predominately L = 2 pattern in later lunar history is a plausible explanation for the present large second-degree non-hydrostatic component in the lunar figure. DOE

N86-29436# Lawrence Livermore National Lab., Calif.
SAC: A SIGNAL PROCESSING SYSTEM FOR RESEARCH SEISMOLOGY
J. E. Tull 1986 5 p Presented at the Institute for Electrical and Electronics Engineers International Conference on Circuits and Systems, San Jose, Calif., 5 May 1986
(Contract W-7405-eng-48)
(DE86-008018; UCRL-94153; CONF-860589-1) Avail: NTIS HC A02/MF A01

The Seismic Analysis Code (SAC) is a general purpose interactive program designed for the study of sequential signals, especially time-series data. Emphasis has been placed on analysis tools used by research seismologists in the detailed study of seismic events. Analysis capabilities include Fourier transforms, three spectral estimation techniques, IIR and FIR filtering, arithmetic operations, a signal stacking, decimation, and seismic phase picking. SAC also contains a very extensive graphics capability. DOE

N86-29437# National Oceanic and Atmospheric Administration, Boulder, Colo.
DIRECTORY OF WORLD SEISMOGRAPH STATIONS. VOLUME 2, EAST ASIA: CHINA, JAPAN, KOREA AND MONGOLIA
S. Miyamura Dec. 1985 277 p Sponsored by NOAA Prepared in cooperation with Oki Electric Industry Ltd., Tokyo, Japan
(PB86-164316) Avail: NTIS HC A13/MF A01 CSCL 08K

Knowledge of the location of seismological instruments, their technical characteristics, dates of operation, and availability of data are fundamental to data exchange and to science. The volume is a directory of world seismograph stations in East Asia: China, Japan, Korea, and Mongolia. GRA

N86-29438# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 495, NOVEMBER 1985. PART 1: (PROMPT REPORTS). DATA FOR OCTOBER 1985, SEPTEMBER 1985 AND LATE DATA
H. E. Coffey, ed. Nov. 1985 84 p
(PB86-165123; SGD-495-Pt-1) Avail: NTIS HC A05/MF A01 CSCL 03B

Solar Geophysical Data Number 495, November 1958; Part 1 (Prompt Reports); Data for October, 1985, September, 1985, and Late Data contains information on the following: Detailed index for 1985; Data for October 1985; IUWDS alert periods (Advance and Worldwide); Solar activity indices, solar flares, solar radio emission, Stanford mean solar magnetic field); Data for September 1985 (solar active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic ray measurements by neutron monitor, geomagnetic indices, radio propagation indices); and geomagnetic indices, calcium plage data for March 1983. GRA

N86-29439# National Geophysical Data Center, Boulder, Colo.
SOLAR-GEOPHYSICAL DATA NUMBER 495, NOVEMBER 1985. PART 2: (COMPREHENSIVE REPORTS). DATA FOR MAY 1985 AND MISCELLANEA
H. E. Coffey, ed. Nov. 1985 86 p
(PB86-165131; SGD-495-Pt-2) Avail: NTIS HC A05/MF A01 CSCL 03B

Solar-Geophysical Data Report Number 495, November 1985; Part 2 (Comprehensive Reports); Data for May 1985, and Miscellanea contains the following information: Detailed index for 1985; Data for April 1985 (Meudon carte synoptique, Solar radio bursts at fixed frequencies, Solar x-ray radiation from GOES satellite, Mass ejections from the sun); Data for July - December 1984--Solar flares July 1984 to December 1984; and Miscellaneous data--Active prominences and filaments May 1985. GRA

N86-29440# Federal Geodetic Control Committee, Washington, D.C.
INPUT FORMATS AND SPECIFICATIONS OF THE NATIONAL GEODETIC SURVEY DATA BASE. VOLUME 3: GRAVITY CONTROL DATA (REVISED SEPTEMBER 1985)
W. T. Dewhurst Sep. 1985 166 p
(PB86-187010) Avail: NTIS HC A08/MF A01 CSCL 08E

The user's guide to the formats and specifications used within the National Geodetic Survey (NGS) data base is commonly referred to as the Blue Book, and is comprised of three volumes. Gravity control (GRAV) data are discussed. GRA

N86-29303*# Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
DYNAMICS OF THE NIGHTTIME THERMOSPHERE AT ARECIBO
R. G. Burnside, J. C. G. Walker, and C. A. Tepley (Arecibo Ionospheric Observatory, Puerto Rico.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 23-28 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29304*# Texas Univ. at Dallas, Richardson. Center for Space Sciences.
MEDIUM AND LARGE-SCALE VARIATIONS OF DYNAMO-INDUCED ELECTRIC FIELDS FROM AE ION DRIFT MEASUREMENTS
W. R. Coley and J. P. McClure *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 29-50 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29305*# Augsburg Coll., Minneapolis, Minn. Dept. of Physics.
ATOMIC NITROGEN DENSITIES NEAR THE POLAR CUSP
M. J. Engebretson and J. T. Nelson *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 51-61 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29306*# National Center for Atmospheric Research, Boulder, Colo.
SIMULATION OF THE THERMOSPHERIC TIDES BY USE OF THE NCAR THERMOSPHERIC GENERAL CIRCULATION MODEL
C. G. Fensen, R. E. Dickinson, and R. G. Roble *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 63-77 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29323*# State Univ. of New York, Albany. Dept. of Atmospheric Science.
MEASUREMENTS OF THERMOSPHERIC RESPONSE TO AURORAL ACTIVITIES
S. Okano (Tohoku Univ., Sendai, Japan) and J. S. Kim *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 269-274 (For primary document see

N86-29307*# Boston Univ., Mass. Dept. of Electrical, Computer and Systems Eng.
TIDAL COUPLING WITH THE LOWER ATMOSPHERE (INVITED REVIEW)
Jeffrey M. Forbes *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 79-96 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29308*# National Center for Atmospheric Research, Boulder, Colo.
THE EFFECT OF BREAKING GRAVITY WAVES ON THE DYNAMICS AND CHEMISTRY OF THE MESOSPHERE AND LOWER THERMOSPHERE (INVITED REVIEW)
Rolando R. Garcia *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 97-103 Sponsored by NSF (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29309*# Liege Univ. (Belgium). Inst. d'Astrophysique.
THERMOSPHERIC NITRIC OXIDE AND ITS ROLE IN THERMOSPHERIC DYNAMICS AND COMPOSITION
J.-Cl. Gerard and R. G. Roble (National Center for Atmospheric Research, Boulder, Colo.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 105-117 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29310*# Polytechnic Inst. of New York, Farmingdale.
GLOBAL LARGE SCALE STRUCTURES IN THE F REGION
S. H. Gross *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 119-135 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29311*# Texas Univ. at Dallas, Richardson. Center for Space Sciences.
THE MEASURED MOTIONS INSIDE EQUATORIAL PLASMA BUBBLES
W. B. Hanson and D. K. Bamgboye (Ilorin Univ., Nigeria) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 137-151 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29312*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UT/LONGITUDINAL VARIATIONS OF COMPOSITION IN DE DATA
A. E. Hedlin *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 153-162 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29313*# Texas Univ. at Dallas, Richardson. Center for Space Science.
CONVECTION PATTERN MORPHOLOGY AND VARIATIONS (INVITED REVIEW)
R. A. Heelis *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 163-178 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29314*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERACTION OF THE EQUATORIAL MIDNIGHT PRESSURE BULGE AND THERMOSPHERIC ZONAL WINDS
F. A. Herrero *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 179-184 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29315*# Michigan Univ., Ann Arbor. Space Physics Research Lab.
ION NEUTRAL COUPLING IN THE HIGH LATITUDE THERMOSPHERE, PART 1
T. L. Killeen *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 185-187 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29316*# Michigan Univ., Ann Arbor. Space Physics Research Lab.
ION-NEUTRAL COUPLING IN THE HIGH LATITUDE THERMOSPHERE, PART 2
T. L. Killeen *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 189-193 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29317*# Clemson Univ., S.C. Dept. of Physics and Astronomy.
GEOSTROPHIC ADJUSTMENT IN A SHALLOW-WATER NUMERICAL MODEL AS IT RELATES TO THERMOSPHERIC DYNAMICS
M. F. Larsen and I. S. Mikkelsen (Danish Meteorological Inst., Copenhagen.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 195-204 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29318*# Air Force Geophysics Lab., Hanscom AFB, Mass.
SATELLITE ACCELEROMETER MEASUREMENTS OF NEUTRAL DENSITY AND WINDS DURING GEOMAGNETIC STORMS
Frank A. Marcos and Jeffrey M. Forbes (Boston Univ., Mass.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 205-219 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29319*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TRANSFER FUNCTION ANALYSIS OF THERMOSPHERIC PERTURBATIONS
H. G. Mayr, I. Harris, F. Varosi (Science Applications Research, Riverdale, Md.), F. A. Herrero, and N. W. Spencer *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 221-231 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29320*# Michigan Univ., Ann Arbor. Space Physics Research Lab.
EQUATORIAL THERMOSPHERIC MEASUREMENTS OF TEMPERATURES AND WINDS AT AREQUIPA, PERU
John W. Meriwether, Jr. and Manfred A. Biondi (Pittsburgh Univ., Pa.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 233-251 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29321*# Michigan Univ., Ann Arbor. Space Physics Research Lab.
POLAR CAP OBSERVATIONS OF THERMOSPHERIC WINDS AND TEMPERATURES AT SONDRE STROMFJORD, GREENLAND
John W. Meriwether, Jr. and P. Shih *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 253-261 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29322*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ZONAL WIND OBSERVATIONS DURING A GEOMAGNETIC STORM
N. J. Miller and N. W. Spencer *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 263-267 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29324*# Massachusetts Inst. of Tech., Cambridge. Haystack Observatory.
INITIAL RESULTS OF THE GLOBAL THERMOSPHERIC MAPPING STUDY (GTMS)
W. L. Oliver, J. E. Salah, R. G. Musgrove, J. M. Holt, V. B. Wickwar (SRI International Corp., Menlo Park, Calif.), G. J. Hernandez (National Oceanic and Atmospheric Administration, Boulder, Colo.), and R. G. Roble (National Center for Atmospheric Research, Boulder, Colo.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 275-296 Original contains color illustrations (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29325*# University Coll., London (England). Dept. of Physics and Astronomy.
OBSERVATIONS OF VERTICAL WINDS AND THE ORIGIN OF THERMOSPHERIC GRAVITY WAVES LAUNCHED BY AURORAL SUBSTORMS AND WESTWARD TRAVELLING SURGES
David Rees *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 297-322 Original contains color illustrations (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29326*# University Coll., London (England). Dept. of Physics and Astronomy.
THE TIME-DEPENDENT DYNAMICAL RESPONSE OF THE THERMOSPHERE TO MAJOR GEOMAGNETIC DISTURBANCES
David Rees *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 323-339 Original contains color illustrations (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29327*# University Coll., London (England). Dept. of Physics and Astronomy.
SELF-CONSISTENT MODELLING OF THE POLAR THERMOSPHERE AND IONOSPHERE TO MAGNETOSPHERIC CONVECTION AND PRECIPITATION (INVITED REVIEW)
David Rees, Tim Fuller-Rowell, Shaun Quegan (Marconi Space and Defence Systems Ltd., Chelmsford England), and Roy Moffett (Sheffield Univ., England.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 341-360 Original contains color illustrations (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29328*# Rice Univ., Houston, Tex. Dept. of Space Physics and Astronomy.
PARTICLE PRECIPITAION INTO THE THERMOSPHERE (INVITED REVIEW)
Patricia H. Reiff *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 361-367 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29329*# Utah State Univ., Logan. Center for Atmospheric and Space Sciences.
A METHOD FOR EXTRACTING MERIDONAL WINDS FROM IONOSONDE MEASUREMENTS BY USING IONOSPHERIC MODELS
P. G. Richards and D. G. Torr *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 369-374 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29330*# Southampton Univ. (England). Dept. of Physics.
THE QUADRUPOLE IONOSPHERE
H. Rishbeth *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 375-377 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29331*# Science Research Council, Chilton (England). Rutherford Appleton Lab.
EISCAT VELOCITY PATTERNS FOR THEORETICAL PLASMA CONVECTION MODELS
H. Rishbeth and J. J. Sojka (Utah State Univ., Logan.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 379-382 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29332*# National Center for Atmospheric Research, Boulder, Colo. High Altitude Observatory.
RESULTS OF VARIOUS STUDIES MADE WITH THE NCAR THERMOSPHERIC GENERAL CIRCULATION MODEL (TGCM) (INVITED REVIEW)
R. G. Roble *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 383-413 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29333*# Massachusetts Inst. of Tech., Cambridge. Haystack Observatory.
MILLSTONE HILL MEASUREMENTS AND TGCM SIMULATION FOR THE 30 MAY 1984 ANNULAR SOLAR ECLIPSE
J. E. Salah, W. L. Oliver, B. A. Emery (National Center for Atmospheric Research, Boulder, Colo.), R. G. Roble, E. C. Ridley, and H. C. Carlson (Air Force Geophysics Lab., Hanscom AFB, Mass.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 415-438 Original contains color illustrations (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29334*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A DYNAMO THEORY PREDICTION FOR SOLAR CYCLE 22: SUNSPOT NUMBER, RADIO FLUX, EXOSPHERIC TEMPERATURE, AND TOTAL DENSITY AT 400 km
K. H. Schatten and A. E. Hedin *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 439-444 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29336*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
JOULE HEATING AND FIELD-ALIGNED CURRENTS: PRELIMINARY RESULTS FROM DE-2
M. Sugiura *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 451-461 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29338*# York Univ. (England). Centre for Research in Experimental Space Science.
WAMDII OBSERVATION OF AN AURORAL ATMOSPHERE WAVE EVENT
R. H. Wiens, G. G. Shepherd, and K. V. Paulson (Saskatchewan Univ., Saskatoon.) *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 467 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 04A

N86-29462# California Univ., La Jolla.
EFFECTS OF EL NINO/SOUTHERN OSCILLATION ON THE ATMOSPHERIC CONTENT OF CARBON DIOXIDE
C. D. Keeling and R. Revelle *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 13 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N86-29441# World Meteorological Organization, Geneva (Switzerland). TOGA Scientific Steering Group.
INTERNATIONAL CONFERENCE ON THE TOGA SCIENTIFIC PROGRAM World Climate Research Program
Sep. 1985 339 p Conference held in Paris, France, 17-21 Sep. 1984 Prepared in cooperation with ICSC, Rome, Italy
(WCRP-4; WMO/TD-65; ESA-86-97075) Avail: NTIS MF A01; print copy available at WMO, Geneva

An international research program to study global atmospheric interactions; El Nino and the Pacific; the monsoon and the Indian Ocean; the tropical Atlantic Ocean; and the biological effects of El Nino and the Southern Oscillation was discussed. For individual titles, see N86-29442 through N86-29464.

N86-29442# Oxford Univ. (England). Clarendon Lab.
AN OVERVIEW OF THE DYNAMICS OF THE TROPICAL OCEANS AND GLOBAL ATMOSPHERE
A. E. Gill *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 12 p (For primary document see N86-29441 20-47)
Avail; NTIS MF A01; print copy available at WMO, Geneva

Atmosphere-ocean coupling in tropical regions is reviewed and its effects on climate are discussed. The relations between atmospheric heating and cloud and rainfall patterns are considered. Atmospheric modeling and wind flow are treated. ESA

N86-29443# Delaware Univ., Lewes.
OBJECTIVES OF THE TOGA CONFERENCE
Ferris Webster *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 4 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

The aims of the Tropical Ocean Global Atmosphere project are to assess knowledge of the interannual variability of the tropical ocean and the global atmosphere and form the scientific basis for a research program. Program objectives are: to determine to what extent the time-dependent behavior of the tropical ocean and global atmosphere system is predictable on time scales of months to years and to understand the mechanism of this behavior; to study the feasibility of modeling the coupled ocean-atmosphere system for predicting its variations on time scales of months to years; and to provide the scientific background for designing an observing and data transmission system for operational prediction if this capability is demonstrated by coupled ocean-atmosphere models. ESA

N86-29444# Washington Univ., Seattle.
ATMOSPHERIC RESPONSE TO EQUATORIAL SEA-SURFACE TEMPERATURE ANOMALIES
J. M. Wallace *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 12 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

The effects of the interaction of the tropical oceans with the global atmosphere on climate are discussed. El Nino and long range weather forecasting are considered. Empirical evidence of global teleconnections between the El Nino Southern Oscillation phenomenon and atmospheric temperature and pressure and rainfall is shown. Equatorial sea surface temperature and precipitation patterns are compared. The effects of changes in equatorial rainfall patterns on higher latitudes through the redistribution of planetary waves are outlined. Atmospheric forcing of the ocean is treated. ESA

N86-29445# Scripps Institution of Oceanography, La Jolla, Calif.
EXTRA-TROPICAL CONNECTIONS
Jerome Namias *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 11 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

Empirical and numerical modeling evidence which strongly indicates that atmospheric forcing must consider not only events in the tropics, but equally in the extra-tropics and polar regions as instigators of climate and weather not only there but even in the tropics is presented. The complementary role of the tropics and extra-tropics in numerical models for predictions on monthly or seasonal time scales is underlined. El Nino's effect on the global climate is discussed. It is stressed that the El Nino-Southern Oscillation phenomenon is only one of a number of interactive and often synergistic forces influencing long range weather forecasting. ESA

N86-29446# Maryland Univ., College Park. Center for Ocean-Land-Atmosphere Interactions.
VARIABILITY OF THE TROPICAL CIRCULATION
J. Shukla and E. M. Rasmusson (National Meteorological Center, Washington, D.C.) *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 16 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

Correlations based on observations and controlled numerical sensitivity experiments with global general circulation models that support the hypothesis that changes in the lower boundary conditions are one of the most significant factors responsible for the interannual variability of the tropical atmosphere are presented. It is shown that a significant fraction of the local interannual variability over different parts of the tropics is a regional manifestation of the planetary scale El Nino-Southern Oscillation-Monsoon phenomenon. Large anomalies in circulation and rainfall, comprising a major portion of the interannual variability, are strongly phase-locked with the seasonal cycle, and major tropical droughts and floods are either due to modulation of the annual cycle or shifts in the locations, or timing of maximum amplitude. It is conjectured that the tropical variability related to the slowly changing boundary conditions, and the associated low frequency planetary scale circulations, is potentially predictable at a range beyond the limits of deterministic predictability. ESA

N86-29447# Hawaii Univ., Honolulu. Dept. of Oceanography.
WATER DISPLACEMENTS DURING 1982-83 AND THE GENESIS OF EL NINO AND THE SOUTHERN OSCILLATION c48
Klaus Wyrtki *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 10 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

Sea level response during 1982-83 to the changing wind system is summarized. Water mass displacements during the 1982-83 El Nino are outlined. The genesis of El Nino and the Southern Oscillation is discussed. For the Tropical Ocean Global Atmosphere (TOGA) program, it is argued that in view of the importance of ocean heat storage for the analysis and understanding of climatic cycles, a complete documentation and continuous monitoring of the heat storage field in the ocean is an indispensable prerequisite for research in TOGA. The heat storage field can be best documented by a program of systematic XBT sections from ships of opportunity, supplemented by drifting thermistor chains and by a network of sea level gages. Data from this network should be available in real time so that monthly maps of ocean heat storage can be compiled and made available for analysis. ESA

N86-29448# National Meteorological Center, Washington, D.C. Climate Analysis Center.
CLIMATE VARIABILITY AND THE SOUTHERN OSCILLATION
Eugene M. Rasmusson *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 11 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

The relationship between the Southern Oscillation and the annual cycle is reviewed. The 1982-83 El Nino-Southern Oscillation event is described. The global nature of the interaction between the event and sea surface temperature anomalies is stressed. ESA

N86-29449# Princeton Univ., N. J. Geophysical Fluid Dynamics Lab.
PREDICTABILITY OF EL NINO **c48**
S. G. H. Philander and N.-C. Lau *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 8 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

The effects of atmospheric and oceanic variability on the predictability of El Nino are discussed, and air-sea interactions are considered. It is argued that El Nino is not caused by instabilities of either the atmosphere or the ocean, but by an instability of the interactions between the tropical ocean and atmosphere. Predictability for periods of weeks to months should be possible because the time-scale for the amplification of initial perturbations is relatively long, and because the perturbations have to satisfy certain conditions in order to amplify. ESA

N86-29450# National Oceanic and Atmospheric Administration, Seattle, Wash. Pacific Marine Environmental Lab.
OBSERVATIONAL STRATEGY FOR TOGA PACIFIC **c48**
Bruce A. Taft *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 11 p Sponsored by NOAA Equatorial Pacific Ocean Climate Studies Program (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

The oceanographic program needed to describe large scale, low frequency variations of key variables for the entire tropical Pacific over a 10yr period is outlined. Measurement of processes which modify the heat content of the upper ocean; ocean model verification; and assimilation of data into predictive models are considered. Use of merchant ships, and moored and drifting thermistor chains to measure the thermal field is suggested. Moored equatorial current measures and surface current measures with drifters are required to study circulation. Sea level can be monitored by existing means. ESA

N86-29451# Florida State Univ., Tallahassee. Dept. of Meteorology.
THE ANNUAL CYCLE OF THE MONSOON OVER THE GLOBAL TROPICS
T. N. Krishnamurti, Naomi Surgi, and John Monobianco *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 21 p (For primary document see N86-29441 20-47)
(Grants NSF ATM-83-04809; NOAA-NA-82AA-D-0004)
Avail: NTIS MF A01; print copy available at WMO, Geneva

Summer and winter patterns of divergent atmospheric circulations are discussed. Longer term variability of the rotational and divergent motions at 200 mb is considered. The sum and difference of these fields during El Nino and non El Nino years reveals tropical teleconnection patterns. Besides the familiar Pacific North American pattern of this data set also reveals an interesting low pressure anomaly over the monsoon region in the upper troposphere. This pattern is associated with a long-lasting westerly anomaly during the El Nino years; the implications of this feature on the evolution of monsoons, are addressed. ESA

N86-29452# Scripps Institution of Oceanography, La Jolla, Calif.
INTERACTION OF THE MONSOON AND TRADEWIND SYSTEM
T. P. Barnett and K. E. Trenberth (National Center for Atmospheric Research, Boulder, Colo.) *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 10 p (For primary document see N86-29441 20-47)
(Grant NSF ATM-82-13279)
Avail: NTIS MF A01; print copy available at WMO, Geneva

A near-global sea level pressure (SLP) field covering the period 1951-80 was developed and analyzed by complex empirical orthogonal function analysis. The results show the existence of a large scale SLP signal that seems to be generated over Asia, move down over the Indian Ocean and propagate eastward across the Pacific. This signal is a dipole with anomalies of different sign in the eastern and western hemispheres. This signal represents the coupling of the monsoon and tradewind systems at interannual time scales. It may also be thought of as an empirical framework for understanding near-global climate variation since it includes the Southern Oscillation, monsoon variation, key tropical-midlatitude teleconnection patterns and numerous other large scale climate features. Study of upper air data in the tropical strip shows the propagating, dipole signal to be confined to levels below 500 mb. Above 500 mb the signal is a monopole covering the entire tropical belt. There is no sign of propagation at these altitudes. ESA

N86-29453# Oxford Univ. (England). Dept. of Atmospheric Physics.
MODELLING THE INDIAN OCEAN **c48**
David L. T. Anderson *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 5 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

Modeling of the response of the equatorial ocean to wind stress since the papers on the Indian Ocean by Lighthill (1969) and Cox (1970) is reviewed. The Somali current and equatorial currents are discussed. ESA

N86-29454# Laboratoire d'Oceanographie Physique, Paris (France).
OBSERVATIONAL STRATEGY FOR TOGA IN THE TROPICAL INDIAN OCEAN
M. Fieux *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 8 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

An observational program to study the processes that control sea surface temperature changes and upper ocean heat content on intraseasonal, annual, and interannual time scales and, in particular, to determine the relative importance of advection, upwelling, surface fluxes, and heat storage is proposed for the Indian Ocean. The program includes XBT observations, drifting buoys, direct sea level measurements, satellite data collection and analysis, and a voluntary observing ship meteorological program. ESA

N86-29455# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
NORTHEAST BRAZIL DROUGHTS AND ATLANTIC SEA SURFACE (SST) ANOMALIES
Antonio Divino Moura *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 8 p (For primary document see N86-29441 20-47)
Avail: NTIS M,F A01; print copy available at WMO, Geneva

Research relating sea surface temperature (SST) anomalies in the Atlantic and rainfall over tropical South America is reviewed. Occurrences of droughts over Northeast Brazil associated with positive SST anomalies over the North and negative SST anomalies over the South tropical Atlantic, respectively, are discussed. Associated with the anomalies is sea level anomalous convergence near warmer waters and anomalous divergence over colder waters. This anomalous circulation is associated with excessive rainfall over the Guianas and severe droughts over NE Brazil. The association of the El Nino phenomenon and droughts over NE Brazil is considered in relation to the Southern Oscillation. Teleconnection of drought occurrences with anomalous cyclonic activity in the Newfoundland area and the role of the position and intensity of the ITCZ are treated. Analysis of the monthly departures of relative vorticity over the globe shows planetary scale wavelike patterns linking the Atlantic to distant regions during years of droughts and floods over NE Brazil. ESA

N86-29456# Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
RELATIONSHIPS OF DROUGHT IN AFRICA TO ANOMALIES IN GLOBAL CIRCULATION
Y. M. Tourre *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 14 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

Global (tropical) and local (African) atmospheric and oceanic patterns associated to Sahelian drought are discussed. Warm equatorial sea surface temperature (SST) seems to correspond to Sahelian dry years. Intensity and thickness of the local monsoon regime upstream of Africa are critical for drought forecasting. Position, intensity, and number of the seasonal Walker cells can be strongly modified. The main ascending branch of the train of East/West circulation cells is often phase locked with the warm pool of SST in the Pacific ocean, while the main subsiding branch is located over west Africa. Zonal circulation indices at 850 mb and 200 mb obtained from the large scale velocity potential field accurately document the diffluent (divergence) part of the windfield over the Atlantic ocean and neighboring Africa. Weak values of the indices at both levels allow the positioning of the subsiding branch, responsible for the lack of precipitation. ESA

N86-29457# Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
DIAGNOSTIC STUDIES OF THE THERMAL STRUCTURE OF THE TROPICAL ATLANTIC OCEAN **c48**
J. Merle *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 17 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

Large scale, low frequency forcings and responses of the tropical Atlantic Ocean are reviewed. The dynamical response of the ocean is described. The heat budget and heat transport are considered. Sea surface temperature response is outlined. The double oscillations of the thermocline on an East-West and North-South rotation imply seasonal redistributions of the heat zonally and meridionally that are an order of magnitude larger and out of phase with the heat flux across the surface. This means that the dynamical interior response of the tropical ocean is the most important for understanding and predicting the ocean's role in the overall climate system. Zonal equatorial heat transport may account for El Nino like phenomena on seasonal time scale or interannual time scale, as in the Pacific. ESA

N86-29458# Valparaiso Univ., Vina del Mar (Chile). Inst. de Oceanologia.
THE EFFECTS OF EL NINO ON SOUTHEAST PACIFIC FISHERIES **c48**
S. Avaria *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 15 p (For primary document see N86-29441 20-47)
MF A01; print copy available at WMO, Geneva

Ecological and economic effects of the 1982 El Nino on the fishing grounds of the Chilean, Peruvian, and Ecuadorian fleets are shown. The primary effect is a dramatic reduction in the anchovy population, with a consequent perturbation of the ecology of the ocean. Jack mackerel latitudinal distribution widened, but stocks remained constant, unlike mackerel whose numbers fell. Shrimp production, however, increased, and mollusks such as scallop greatly increased. The sea bird population of Peru fell from 6 million adults in March 1982 to 0.3 million in May 1983. Sardine response was extremely varied, the species dissapearing off Ecuador, remaining stable off Peru, and greatly increasing off Chile. ESA

N86-29459# Far Seas Fisheries Research Lab., Shimizu (Japan). Div. of Oceanography and Southern Ocean Resources.
EFFECT OF EL NINO ON FISH MIGRATION AND YIELD IN THE WESTERN PACIFIC OCEAN **c48**
Hajime Yamanaka *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 7 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

The abnormally cold water temperatures in the western Pacific Ocean caused by the 1982 El Nino event are shown. The relationship between the occurrence of El Nino and changes in the distribution and migration of the Pacific bluefin tuna is discussed. The relationship between El Nino and fluctuations in stocks of the Japanese sardine is considered. Abnormal migration and distribution of fishes and marine mammals around Japan during 1983-84 are analyzed. ESA

N86-29460# Duke Univ. Beaufort, N.C. Marine Lab.
PLANKTON PRODUCTION DURING EL NINO **c48**
Francisco P. Chavez and Richard T. Barber *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 9 p (For primary document see N86-29441 20-47)
(Grant NSF OCE-81-10702)
Avail: NTIS MF A01; print copy available at WMO, Geneva

A decrease in primary plankton productivity of 1 gigaton C during the 300-day duration of the 1982-83 El Nino is estimated. The fraction of this anomaly which can be attributed to a decrease in new production is 0.6 gC, but this new production anomaly is approximately equivalent to a predicted degassing anomaly of 0.57 gC. Models which consider degassing from equatorial upwelling as an important contributor to atmospheric carbon dioxide levels should also consider the effects of upwelling on new primary production. ESA

N86-29461# Museum of Natural History, Los Angeles, Calif.
THE ROLE OF CENTRAL PACIFIC SEABIRDS IN PREDICTING THE 1982-83 ENSO **c48**
Ralph W. Schreiber and Elizabeth Anne Schreiber *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 6 p (For primary document see N86-29441 20-47)
(Grants NSF OCE-83-08756; NSF OCE-84-04152; NGS-265783)
Avail: NTIS MF A01; print copy available at WMO, Geneva

The ornithology of tropical seabirds, particularly those on Christmas Island, is introduced. It is suggested that since the birds react to changes in oceanographic parameters by changes in, e.g., breeding patterns, it may be possible to predict events such as El Nino by studying data on the birds. ESA

N86-29462# California Univ., La Jolla.
EFFECTS OF EL NINO/SOUTHERN OSCILLATION ON THE ATMOSPHERIC CONTENT OF CARBON DIOXIDE **c46**
C. D. Keeling and R. Revelle *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 13 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

The relationship between the quasi-global character and interconnectedness of the Southern Oscillation phenomenon and the behavior of CO2 in the atmosphere is discussed. Interannual and spatial variations in the concentration and isotopic composition of atmospheric CO2 are related to the changes in oceanic and atmospheric circulation that accompany the hemispheric oscillation of air pressure across the South Pacific. Oceanwide time-series measurements of the partial pressure of CO2 and the concentration of dissolved inorganic carbon in subsurface ocean waters are needed to elucidate these relationships. Deeper understanding also requires studies of the temporal and spatial fluctuations in marine biological production and gas exchange across the sea surface. ESA

N86-29463# Delaware Univ., Lewes.
THE OVERALL PLAN: A SCIENTIFIC STRATEGY **c42**
Ferris Webster *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 5 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

The aims of the Tropical Ocean Global Atmosphere project are to assess knowledge of the interannual variability of the tropical ocean and the global atmosphere. Program objectives are: to determine to what extent the time-dependent behavior of the tropical ocean and global atmosphere system is predictable on time scales of months to years and to understand the mechanism of this behavior; to study the feasibility of modeling the coupled ocean-atmosphere system for predicting its variations on time scales of months to years; and to provide the scientific background for designing an observing and data transmission system for operational prediction if this capability is demonstrated by coupled ocean-atmosphere models. ESA

N86-29464# World Meteorological Organization, Geneva (Switzerland).
NATIONAL AND REGIONAL ACTIVITIES RELATED TO THE TROPICAL OCEAN GLOBAL ATMOSPHERE (TOGA) PROJECT c42
In its International Conference on the TOGA Scientific Program Sep. 1985 62 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

The contributions of the Australian, Canadian, Chinese, French, Indian. Indonesian, Mauritian, New Zealand, Senegalese, Seychelles, USSR, UK, USA, and Uraguyan meteorological and oceanographic services to the Tropical Ocean Global Atmosphere project are summarized. Joint investigations of El Nino are described.
ESA

N86-29465*# Chicago Univ., Ill. Lab. for Atmospheric Probing.
ANALYSIS OF DOPPLER LIDAR WIND MEASUREMENTS Final Technical Report
Ramesh C. Srivastava May 1986 67 p
(Contract NAS8-34770)
(NASA-CR-178849; NAS 1.26:178849) Avail: NTIS HC A04/MF A01 CSCL 04B

Doppler lidar and multiple Doppler radar data were obtained in a convectively mixed planetary boundary layer. The lidar measurements were possible due to scattering from existing aerosols; radar reflecting chaff was released in the atmosphere to make it visible to the multiple Doppler radar network. The data were analyzed to obtain detailed horizontal wind structures. The divergence of the horizontal wind was calculated and the anelastic continuity equation integrated to obtain vertical air motions. Differences between the areally averaged quantities and the grid point values provided a measure of the fluctuations in the wind components or the turbulent wind fluctuations. Vertical profiles of the mean winds and quantities related to the turbulent kinetic energy components and the turbulent momentum transfers were also calculated. M.G.

N86-29466*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
A SIMPLIFIED MODEL OF THE TURBULENT MICROBURST
L. Roberts and Tung Wan Mar. 1985 27 p
(Contract NCC2-270)
(NASA-CR-177108; NAS 1.26:177108; SU-JIAA-TR-59) Avail: NTIS HC A03/MF A01 CSCL 04B

A simple model was developed to describe the low altitude shear associated with a microburst (or small downburst) in the atmosphere. Such microbursts are thought to be the cause of convective radial flows near the ground which represent potentially hazardous conditions to aircraft during approach and landing. Closed form solutions are presented for the equations of mass, momentum, and thermal energy to give the spreading rate of the microburst and the velocity and temperature decay due to turbulence. An analysis of the impact of the microburst and its radial spreading over the ground is given and illustrated examples are provided. The solution for the downward and outward wind velocities are given in terms of simple dimensionless algebraic parameters which can be computed readily in realtime during a piloted simulation of an aircraft flying through a microburst. Author

N86-29467# Finnish Meteorological Inst., Helsinki.
A STUDY OF THE DIFFERENCES BETWEEN VARIOUS METHODS IN USE FOR THE REDUCTION OF ATMOSPHERIC PRESSURE
Eino Hellsten and Daniel Soederman Dec. 1985 18 p
(FMI-TR-30; ISBN-951-697-230-6; ISSN-0355-1733) Avail: NTIS HC A02/MF A01

Attention is drawn to the differences between the numerous reduction formulae used by World Meteorological Organization (WMO) members for converting the surface pressure measured at observing stations considerably above sea level (500 m or more) to mean sea level pressure. No particular method so far has been recommended by the WMO, but certain steps towards standardization of conversion methods are apparently needed. Some progress has already taken place in this regard. The Extraordinary Session of the WMO Commission for Basic System in its meeting from 21 October to 1 November 1985 in Hamburg agreed that urgent action was necessary to standardize the procedure for pressure reduction. The Commission decided to refer this task to a group of experts to develop a proposal for the solution of this problem. The differences between the reduction formulae used by various countries is studied in some detail.
Author

N86-29468# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
OBJECTIVE ANALYSIS OF TROPICAL CYCLONE INTENSITY, STRENGTH, AND SIZE USING ROUTINE AIRCRAFT RECONNAISSANCE DATA M.S. Thesis
Charles B. Stanfield May 1986 126 p
(AD-A166417; AFIT/CI/NR-86-28T) Avail: NTIS HC A07/MF A01 CSCL 04/2

The feasibility of objectively analyzing routine aircraft reconnaissance data for the purpose of quantifying tropical cyclone intensity, strength, and size is examined. A computer program is developed which may be used in near real time or after the fact to evaluate localized pressure/wind relationships in the tropical cyclone environment. This program compensates for the system motion and the relative position of the point of observation relative to the vortex center location at flight level and at the surface (thus accounting for the vertical tilt of the center). A representative set of data is obtained over a 13 month period for the entire spectrum of storms from tropical depression to super typhoon. These data are used to try to establish empirical pressure/wind relationships and a means of determining effective storm size. It is shown that a program of this nature may be used with gradient wind and pressure gradient relationships to evaluate intensity and strength and to define storm size, provided adequate data are available at sufficient distances from the center. Author (GRA)

N86-29469# Naval Research Lab., Washington, D. C.
A SIMPLE MODEL OF AEROSOL OPTICAL PROPERTIES IN A WELL-MIXED BOUNDARY LAYER FOR A WAVELENGTH OF 0.50 MICROMETERS
J. W. Fitzgerald 25 Mar. 1986 25 p
(AD-A166433; NRL-MR-5764) Avail: NTIS HC A02/MF A01 CSCL 04/2

A simple model to predict the aerosol optical properties in the marine boundary layer at visible wavelengths is described. The model assumes that the boundary layer is well mixed and predicts the vertical profile of aerosol extinction and the aerosol optical thickness given the relative humidity, temperature and aerosol extinction coefficient at the surface (shipboard level) and the height of the boundary layer. The model is presented in the form of both analytical approximation formulas and nomograms. GRA

N86-29470# Midwest Research Inst., Kansas City, Mo.
SOLERAS. UNIVERSITY RESEARCH PROJECT: GEORGIA INSTITUTE OF TECHNOLOGY. ATLAS OF SATELLITE INSOLATION IN THE US, MEXICO AND SOUTH AMERICA
1986 285 p
(Contract DE-AC02-83CH-10093)
(DE86-005641; MRI/SOL-1704) Avail: NTIS HC A13/MF A01

A summary is given of the development, testing and applications of the satellite insolation estimation project of the National Oceanic and Atmospheric Administration (NOAA) Agriculture and Resources Inventory Surveys through Aerospace Remote Sensing (AgRISTARS) program. The NOAA/AgRISTARS procedure uses data from the Geostationary Operational Environmental Satellite (GOES) to estimate daily total insolation (on a horizontal surface) at an array of 1 deg. x 1 deg. latitude-longitude locations throughout the continental United States, Mexico, and parts of South America. This methodology is compared with some other satellite techniques in terms of accuracy and applicability. Summary maps of monthly average daily total insolation for the period July 1982 through December 1983, as well as annual total maps for 1983, are presented for all three geographic coverage areas. As measures of temporal and spatial variability, monthly and annual data are

also presented for the standard deviation of the daily insolation values about the monthly mean, and for root-mean-square values of both north-south and east-west differences over 1 deg. latitude or longitude spacing. From the estimated error analysis the monthly mean values appear to be accurate to about 5% of the mean value, except for the western part of the United States when GOES-1 was put back into temporary service as the western GOES satellite. DOE

N86-29471# Pacific Northwest Lab., Richland, Wash.
RESEARCH ON TURBULENT WIND IN THE US WIND ENERGY TECHNOLOGY PROGRAM
J. R. Connell Nov. 1985 28 p Presented at the 14th IEA Experts Meeting on Turbulence Loads on Wind Turbines, Stockholm, Sweden, 4 Dec. 1985
(Contract DE-AC06-76RL-01830)
(DE86-004871; PNL-SA-13562; CONF-851259-1) Avail: NTIS HC A03/MF A01

Redesign and analytical testing of turbine rotors, after the fluctuating forces of operating in the turbulent wind have been experienced, often place a high priority on accounting for the details of turbulence. Thus the part of the DOE wind energy technology program dedicated to turbulent wind characterization has found a strong coupling with the primary DOE program elements of aerodynamics and mechanical design and testing of wind turbines. The responsibility for turbulence research and the characterization and modeling of turbulence experienced by wind turbines has been assigned to DOE's Pacific Northwest Laboratory. Inter-laboratory cooperative activities with Sandia and the NASA, and more recently with the Solar Energy Research Institute (SERI), have transformed some of the basic research done by PNL into interim models of turbulent wind specialized for their particular use of aerodynamics models. This paper outlines the US DOE wind energy technology program's past progress in turbulence wind research, current activity and future directions. DOE

N86-29472# Brookhaven National Lab., Upton, N. Y.
AQUEOUS-PHASE REACTIONS IN CLOUDS
S. E. Schwartz Nov. 1985 10 p Presented at the 191st American Chemical Society National Meeting, New York, N.Y., 13 Apr. 1986
(Contract DE-AC02-76CH-00016)
(DE86-005249; BNL-37332; CONF-860425-15) Avail: NTIS HC A02/MF A01

Reaction of dissolved gases in clouds occurs by the sequence gas-phase diffusion, interfacial mass transport, and concurrent aqueous-phase diffusion and reaction. Evaluation of the rate of such reactions requires information of two types, fundamental and situational. Fundamental data, determined by laboratory experiments, include equilibrium constants, gas solubilities, kinetic rate laws, including dependence on pH and catalysts or inhibitors, diffusion coefficients, and mass-accommodation coefficients. Situational data, which must be measured in the field or else modeled or assumed, include pH and concentrations of reagents and other species influencing reaction rates, liquid-water content, drop size distribution, insolation, temperature, etc. Aqueous-phase oxidation of S(IV) by H2O2 and O3 can be important for representative conditions. Free-radical reactions may also be significant. No important aqueous-phase reactions of nitrogen species have been identified. Field measurements and studies of reaction kinetics in authentic precipitation samples are consistent with these evaluations. DOE

N86-29473# Pacific Northwest Lab., Richland, Wash.
ACCURATE DETERMINATION OF WIND SPEEDS OVER A MICROSCALE AREA USING A NUMERICAL MODEL
J. C. Barnard, H. L. Wegley, and T. R. Hiester Aug. 1985 7 p Presented at the WINDPOWER '85, San Francisco, Calif., 27 Aug. 1985 Prepared in cooperation with FloWind Corp., Pleasanton, Calif.
(Contract DE-AC06-76RL-01830)
(DE86-001644; PNL-SA-13114; CONF-850834-5) Avail: NTIS HC A02/MF A01

This paper describes a technique of using a mass-consistent numerical model to derive wind speeds over a microscale region of complex terrain. A serious limitation in the use of these numerical models is the sensitivity of the calculated wind field to some of the input parameters, such as that used to simulate the atmospheric stability, for which accurate values are not usually known. However, values for these parameters can be found by tuning the model to existing wind observations within a microscale area. This tuning uses a single-variable, unconstrained optimization procedure that adjusts the unknown parameters so that the error between the observed winds and model calculations of these winds is minimized. Model verification is accomplished using eight cases of hourly averaged wind data, obtained from measurements made at approximately 30 sites covering a wind farm development in the Altamont Pass area. When the model was tuned to a small subset of the 30 sites, an accurate determination of the wind speeds was made for the remaining sites in six of the eight cases. (The two that failed were low wind speed cases.) Therefore, when this technique is used, numerical modeling shows great promise as a tool for microscale siting of wind turbines in complex terrain. DOE

N86-29474# World Climate Programme, Geneva (Switzerland).
REPORT OF THE THIRD SESSION OF THE JSC/CCCO WORKING GROUP ON SATELLITE OBSERVING SYSTEMS FOR CLIMATE RESEARCH
Oct. 1985 34 p Session held in Madison, Wisc., 29 Apr. - 2 May 1985
(WCP-105; ESA-86-97071) Avail: NTIS MF A01; HC at WMO, Geneva, Switzerland

Satellite data access; temperature and moisture soundings; geostationary satellite wind vectors; cloud climatology; radiation budget climatology; precipitation climatology; sea surface temperature; global winds; surface wind and wind stress; ocean surface topography and geostrophic component of ocean circulation; sea ice; land surface climatology; air-sea interface fluxes; distribution of chlorophyll and small flux patterns; aerosols; and the global positioning system were discussed. ESA

N86-29475# World Climate Programme, Geneva (Switzerland).
REPORT OF THE THIRD SESSION OF THE JSC/CCCO TOGA SCIENTIFIC STEERING GROUP
Nov. 1985 80 p Session held in La Jolla, Calif., 22-26 Apr. 1985
(WCP-107; ESA-86-97073) Avail: NTIS MF A01; HC at WMO, Geneva, Switzerland

Implementation of observational and data processing activities for the Tropical Oceans and Global Atmosphere (TOGA) program was reviewed. Tropical sea-level; ocean subsurface data; ocean surface circulation; ocean-atmosphere interface fluxes; sea surface temperature; surface wind/wind stress; precipitation; analyses of atmospheric meteorological parameters for TOGA; ocean modeling; use of real-time products in tropical ocean modeling and dissemination of predictions based on these; TOGA real-time monitoring strategy; and satellite observing systems for TOGA were discussed. ESA

N86-29476# World Meteorological Organization, Geneva (Switzerland). TOGA Scientific Steering Group.
SCIENTIFIC PLAN FOR THE TROPICAL OCEAN AND GLOBAL ATMOSPHERE PROGRAM
Sep. 1985 173 p
(WCRP-3; ESA-86-97074) Avail: NTIS MF A01; HC at WMO, Geneva, Switzerland

The Tropical Ocean and Global Atmosphere plan includes a description of the variability of the atmosphere, ocean, and the coupled ocean/atmosphere system. The development of coupled ocean/atmosphere models for simulating and eventually predicting this variability is discussed. Data requirements for the program for diagnostic and process studies and for model development and validation are specified. The observing systems needed to provide these are described and the data management activity to assemble consistent quality controlled global data sets is outlined. ESA

N86-29477# World Meteorological Organization, Geneva (Switzerland).
FIRST IMPLEMENTATION PLAN FOR THE WORLD CLIMATE RESEARCH PROGRAM
Nov. 1985 151 p
(WCRP-5; ESA-86-97076) Avail: NTIS MF A01; HC at WMO, Geneva, Switzerland

The World Climate Research Program activities are organized according to six subprograms whose objectives are to establish the physical basis of long range weather forecasting; understand the predictable aspects of global climate variations over periods of several months to several years, and assess the response of climate to natural or man-made influences over periods of several decades. The subprograms are: Atmospheric Climate Prediction; Coupled Atmosphere-Ocean Boundary Layer; Tropical Ocean and Global Atmosphere project; World Ocean Circulation Experiment; Cryosphere; and Climatic Sensitivity Assessment. ESA

N86-29478# World Meteorological Organization, Geneva (Switzerland).
WORLD WEATHER WATCH. REGIONAL ASSOCIATION 4 (NORTH AND CENTRAL AMERICA) HURRICANE OPERATIONAL PLAN
1985 79 p
(WMO-524; ISBN-92-63-10524-3; ESA-86-97077) Avail: NTIS MF A01; HC at WMO, Geneva, Switzerland

A plan to enhance the cooperative efforts of Members within WMO Region 4 in carrying out their roles in preparing for and issuing forecasts and warnings of all tropical cyclones affecting the area is presented. Responsibilities of Members are defined. Tropical cyclone releases issued by the Regional Meteorological Center Miami are explained and examples provided. Observational platforms, including land-based radar, satellites, and aircraft reconnaissance are discussed. Where differences exist between the USA's National Hurricane Operational Plan (NHOP) and this plan, aircraft radar and upper-air observations made by the US Department of Defense comply with NHOP. Communication procedures are outlined emphasizing headings required to assure computer-processing and distribution of messages. Hurricane names for the Caribbean Sea, Gulf of Mexico, North Atlantic Ocean, and the eastern North Pacific are included. ESA

N86-29479# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abt. Numerische Modelle.
A QUESTIONNAIRE ON COLD FRONTS IN ALPINE REGIONS
Klaus-Peter Hoinka and Roger K. Smith Jan. 1986 81 p In ENGLISH and GERMAN
(DFVLR-Mitt-86-02; ISSN-0176-7739; ESA-86-97452) Avail: NTIS HC A05/MF A01; DFVLR, Cologne, West Germany, DM 23

Replies to a questionnaire concerning the analysis and prognosis of cold fronts over and in the vicinity of the European Alps from Austrian, Canadian, French, German, and Swiss meteorologists are summarized. It addresses matters such as the relative use of satellite, radar, conventional surface, and upper air-data, and numerical forecast products for the analysis and prognosis of fronts. It seeks to determine those aspects of frontal analysis and prognosis the forescasters consider important for future research. ESA

N86-29480# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Physik der Atmosphaere.
PARAMETERIZATION OF CLOUD-MICROPHYSICAL PROCESSES IN A THREE-DIMENSIONAL CONVECTIVE MESOSCALE MODEL
Hartmut Hoeller Dec. 1985 86 p
(DFVLR-FB-86-02; ISSN-0171-1342; ESA-86-97456) Avail: NTIS HC A05/MF A01; DFVLR, Cologne, West Germany, DM 23.50

A parameterization scheme of cloud-microphysical processes appropriate for 3-D numerical convection model is described. Bulk-physical formulations for the mass transfer rates between the different kinds of particles like cloud droplets, raindrops, frozen cloud droplets, frozen raindrops, ice crystals, snowflakes, graupels, and hailstones are given. The model considers liquid phase (autoconversion and accretion of droplets) as well as ice phase processes (nucleation, aggregation, accretion, riming and melting). ESA

N86-29481# Environmental Protection Agency, Research Triangle Park, N.C. Atmospheric Sciences Research Lab.
MPDA-1: METEOROLOGICAL PROCESSOR FOR DIFFUSION ANALYSIS, USER'S GUIDE
J. Paumier, D. Stinson, T. Kelly, C. Bollinger, and J. S. Irwin Mar. 1986 184 p Prepared in cooperation with Computer Sciences Corp., Research Triangle Park, N. C.
(PB86-171402; EPA/600/8-86/011) Avail: NTIS HC A09/MF A01 CSCL 04B

Version I of the Meteorological Processor for Diffusion Analysis (MPDA-1) is a first attempt to provide a processor that can organize avaliable meteorological data into a format accessible to diffusion analysis. MPDA-1 provides methods for preparing three types of data: National Weather Service (NWS) twice-daily radio-sonde reports, NWS hourly surface observations, and user-supplied on-site data. To incorporate the surface scaling parameters, the meteorological processor is structured in accordance with current concepts of the idealized states of the planetary boundary layer. Profiles of wind velocity, temperature, and the standard deviations of vertical and lateral wind velocity fluctuations at user-specified heights are estimated. The output from MPDA-1 was formatted to accommodate the TUPOS Gaussian-plume model, which uses wind fluctuation data to characterize the diffusion parameters. Future versions will provide additional output formats to accommodate other popular diffusion estimation models. GRA

N86-29482# National Oceanic and Atmospheric Administration, Boulder, Colo. Air Resources Lab.
GEOPHYSICAL MONITORING FOR CLIMATIC CHANGE, NUMBER 13 Summary Report, 1984
E. C. Nickerson Feb. 1986 122 p
(PB86-169661) Avail: NTIS HC A06/MF A01 CSCL 04B

Geophysical Monitoring for Climatic Change Report Number 13(Summary Report 1984) discusses the following: Observatory reports; Aerosols and radiation group; Carbon dioxide group; Trace gases group; Acquisition and data management group; and Director's office continuing programs. GRA

N86-29483# National Weather Service, Honolulu, Hawaii.
TROPICAL CYCLONES, 1984, CENTRAL NORTH PACIFIC
W. Au, A. Chun, A. Inouye, L. Iwai, and H. Rosendal Mar. 1986 31 p
(PB86-183951; NOAA-TM-NWSTM-PR-30) Avail: NTIS HC A03/MF A01 CSCL 04B

Tropical storms in the Central North Pacific Ocean for 1984 are described and classified. GRA

N86-29484# National Weather Service, Washington, D.C. Climate Analysis Center.
MONTHLY AND SEASONAL WEATHER OUTLOOK FOR MAY 1986, VOLUME 40, NUMBER 9, APRIL 29, 1986
29 Apr. 1986 10 p
(PB86-191053) Avail: NTIS HC A02/MF A01 CSCL 04B

Temperature and precipitation probabilities for the monthly and seasonal weather for North America are given. GRA

N86-29485# National Weather Service, Salt Lake City, Utah. Western Region.
MESOSCALE CONVECTIVE COMPLEX TYPE STORM OVER THE DESERT SOUTHWEST
D. Randerson Apr. 1986 65 p
(PB86-190998; NOAA-TM-NWS-WR-196) Avail: NTIS HC A04/MF A01 CSCL 04B

On 10 August 1981 a mesoscale convective complex (MCC) developed over extreme east-central Nevada and moved south-southeastward into northwestern Arizona. The storm affected a total area of nearly 200,000 square kilometers, traveled ap-

proximately 500 km, and lasted nearly 15 hrs. Strong surface winds, hail, heavy rain, and dense blowing dust and sand were reported on the right flank of the MCC. Estimated rainfall rates of 3 to 4 in/hr produced total rainfall amounts of 3 to 6 in over a large area to the northeast of Las Vegas, Nevada. GRA

N86-29486# Bureau of Reclamation, Denver, Colo. Div. of Atmospheric Resources Research.
PROJECT SKYWATER: THE 1984-85 SCPP (SIERRA COOPERATIVE PILOT PROJECT) DATA INVENTORY
Aug. 1985 263 p
(PB86-184512) Avail: NTIS HC A12/MF A01 CSCL 04B

The report contains an inventory of all data collected from October 15, 1984, through April 1985 in association with the Sierra Cooperative Pilot Project (SCPP), a weather modification research project in winter orographic cloud seeding. GRA

N86-29487# General Accounting Office, Washington, D. C. Resources Community and Economic Development Div.
WEATHER SATELLITES: USER VIEWS ON THE CONSEQUENCES OF ELIMINATING A CIVILIAN POLAR ORBITER
Mar. 1986 62 p
(PB86-180254; GAO/RCED-86-111; B-222140) Avail: NTIS HC A04/MF A01 CSCL 04B

It was found that the polar orbiters are used by NOAA for weather forecasting, search and rescue operations, and other purposes; by NASA for climate research; by DOD as a supplement and backup to its own weather satellites; and by countries worldwide for weather forecasting and environmental data collection. Some users in NOAA and DOD reported that the elimination of one of NOAA's polar-orbiting weather satellites would harm their programs, but most users said that they would continue their programs with one satellite. All user's, however, said that the second satellite was important as a backup to the first and that the loss of all service would have serious consequences. GRA

N86-29283*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROGRAM STATUS
Paul Smith *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 19 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29287*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
ISCCP REDUCED RESOLUTION SATELLITE RADIANCE DATA
William Rossow *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 23 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29288*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
THE FIRE PROJECT
David McDougal *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot climate Data System Workshop 1986 11 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29289*# Iowa State Univ. of Science and Technology, Ames. Dept. of Meteorology.
USING PCDS TO STUDY THE INFLUENCE OF UV FLUX VARIATION ON THE MIDDLE ATMOSPHERE
Warren Heilman *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 12 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29290*# Michigan Univ., Ann Arbor.
PCDS AS A TOOL IN TEACHING AND RESEARCH AT THE UNIVERSITY OF MICHIGAN
Vincent Abreu *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 3 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29291*# National Oceanic and Atmospheric Administration, Washington, D. C. National Environmental Satellite Data and Informat.
PLANNING FOR THE UTILIZATION OF THE PCDS IN STUDYING THE INTERACTION OF CLOUDS (ISCCP-C DATA) AND THE EARTH RADIATION BUDGET (ERBE DATA)
Herbert Jacobowitz *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 7 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29292*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UV ALBEDO OF CLOUDS FROM TOMS DATA
David Short *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 8 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29293*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF RAINFALL OVER NORTHERN PERU DURING EL NINO: A PCDS APPLICATION
Richard Goldberg and Gilberto Tisnado (Instituto Nacional de Investigacion de Transportes (Peru).) *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 23 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

48 OCEANOGRAPHY

Includes biological, dynamic and physical oceanography; and marine resources.

N86-29488# Science Applications International Corp., College Station, Tex.
A STUDY OF SEA ICE KINEMATICS AND THEIR RELATIONSHIP TO ARCTIC AMBIENT NOISE. PART 1. TECHNICAL PAPERS. PART 2. ICE AND ATMOSPHERIC PARAMETERS Final Report, Mar. 1985 - Feb. 1986
James K. Lewis and Warren W. Denner Feb. 1986 346 p refs
(Contract N00014-85-C-0531)
(AD-A165303; AD-E301922; SAIC-85/1950-Pt-1/2;
SAIC-1-425-07-356-10-Pt-1/2) Avail: NTIS HC A15/MF A01 CSCL 08/12

This report details a study of sea ice processes and ambient noise variations from data sets collected during the Arctic Ice Dynamics Joint Experiment (AIDJEX) in 1975 and 1976. The data, which come from buoys drifting with the ice for over one year in the Beaufort Sea, consist of ambient noise, position, atmospheric temperature and pressure, etc. and a number of other parameters. This volume includes technical papers on: Calculation of an Effective Ice Thickness Term for Pack Ice Using Lagrangian Data; Seasonal Variability of the Principle Modes of Ice Movement in the Beaufort Sea; Arctic Ambient Noise in the Beaufort Sea and Its Relationship to Sea Ice Kinematics. Also included are a number of appendices that present most of the ice and atmospheric data used in this study in graphical format. GRA

N86-29489# Sea Tech, Inc., Corvallis, Oreg.
REMOTE OPTICAL SETTLING TUBE Final Report, for FY 1984
R. Bartz 28 Feb. 1986 46 p
(Contract N00014-84-C-0045)
(AD-A165736) Avail: NTIS HC A03/MF A01 CSCL 08/10

A remote optical settling tube was designed, calibrated and tested at Sea Tech, Inc. The instrument was delivered to the Woods Hole Oceanographic Institution where it underwent preliminary field testing. Problems encountered in the field testing

phase were addressed and solved at Sea Tech and the instrument was returned to Woods Hole for deployment. The remote optical settling tube was moored in the Atlantic Ocean as part of the ongoing HEBBBLE research program. Recovery of the mooring will take place in April 1986. Software was developed and tested at Sea Tech for the analysis of data from the settling tube. This software has been used successfully on a previous data set obtained with a prototype optical settling tube. GRA

N86-29490# Skidaway Inst. of Oceanography, Savannah, Ga.
COORDINATION: SOUTHEAST CONTINENTAL SHELF STUDIES Progress Report, 1 Jun. 1984 - 31 Dec. 1985
D. W. Menzel and J. O. Blanton 3 Jan. 1986 33 p
(Contract DE-AS09-76EV-00901)
(DE86-005139; DOE/EV-00901/T5) Avail: NTIS HC A03/MF A01

This overview and report of progress on the South Atlantic Bight Program includes discussions of: (1) dynamics of the coastal zone; (2) circulation studies; (3) biological transformations in the coastal boundary zone; (4) sediment geochemistry; and (5) continental shelf processes. DOE

N86-29491# Danish Meteorological Inst., Copenhagen.
THE ICE CONDITIONS IN THE GREENLAND WATERS, 1974
Sep. 1985 113 p In ENGLISH and DANISH
(ISBN-87-7478-249-5; ESA-86-97064) Avail: NTIS HC A06/MF A01

Monthly ice charts for the entire Greenland region and local reconnaisance charts are presented. ESA

N86-29492# World Climate Programme, Geneva (Switzerland).
REPORT OF THE TOGA DRIFTERS PLANNING MEETING
Sep. 1985 35 p Meeting held in La Jolla, Calif., 27-29 Mar. 1985
(WCP-103; ESA-86-97072) Avail: NTIS MF A01; HC at WMO, Geneva, Switzerland

Mechanisms for specifying a set of criteria for the parameters to be measured by TOGA drifters and for describing the engineering performance standards which the buoys need to attain were defined. There should be no attempt to standardize the types of buoys which may be deployed for TOGA, but there should be an attempt to standardize the types of calibration and system performance information, which are required to be part of the research buoy data sets. ESA

N86-29493# Ecole Polytechnique, Palaiseau (France). Lab. d'Optique Appliquee.
GYROMETRY USING PASSIVE RESONANT CAVITIES [GYROMETRIE A CAVITE RESONNANTE PASSIVE]
Y. B. Andre, B. Lamouroux, and B. Prade 17 Dec. 1985 16 p In FRENCH and ENGLISH
(Contract DRET-81-495)
(ESA-86-97206) Avail: NTIS HC A02/MF A01

An electromagnetic resonant cavity is formed by an optical fiber ring in order to measure the angular velocity of the body carrying the fiber loop. The light inlet and outlet are assured by optical couplers which were specifically designed. The system presents multiple resonance peaks under varying laser frequencies. The measurement of the difference between resonant frequencies of waves traversing the ring in the opposite direction allows a sensitivity of the order of 0.03 deg/hr/Hz. The practical realization of the system with and He-Ne laser shows a background noise equivalent to 100 deg/hr. ESA

N86-29447# Hawaii Univ., Honolulu. Dept. of Oceanography.
WATER DISPLACEMENTS DURING 1982-83 AND THE GENESIS OF EL NINO AND THE SOUTHERN OSCILLATION
Klaus Wyrtki *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 10 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

N86-29449# Princeton Univ., N. J. Geophysical Fluid Dynamics Lab.
PREDICTABILITY OF EL NINO
S. G. H. Philander and N.-C. Lau *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 8 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

N86-29450# National Oceanic and Atmospheric Administration, Seattle, Wash. Pacific Marine Environmental Lab.
OBSERVATIONAL STRATEGY FOR TOGA PACIFIC
Bruce A. Taft *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 11 p Sponsored by NOAA Equatorial Pacific Ocean Climate Studies Program (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

N86-29453# Oxford Univ. (England). Dept. of Atmospheric Physics.
MODELLING THE INDIAN OCEAN
David L. T. Anderson *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 5 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

N86-29457# Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
DIAGNOSTIC STUDIES OF THE THERMAL STRUCTURE OF THE TROPICAL ATLANTIC OCEAN
J. Merle *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 17 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

N86-29458# Valparaiso Univ., Vina del Mar (Chile). Inst. de Oceanologia.
THE EFFECTS OF EL NINO ON SOUTHEAST PACIFIC FISHERIES
S. Avaria *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 15 p (For primary document see N86-29441 20-47)
MF A01; print copy available at WMO, Geneva

N86-29459# Far Seas Fisheries Research Lab., Shimizu (Japan). Div. of Oceanography and Southern Ocean Resources.
EFFECT OF EL NINO ON FISH MIGRATION AND YIELD IN THE WESTERN PACIFIC OCEAN
Hajime Yamanaka *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 7 p (For primary document see N86-29441 20-47)
Avail: NTIS MF A01; print copy available at WMO, Geneva

N86-29460# Duke Univ. Beaufort, N.C. Marine Lab.
PLANKTON PRODUCTION DURING EL NINO
Francisco P. Chavez and Richard T. Barber *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 9 p (For primary document see N86-29441 20-47)
(Grant NSF OCE-81-10702)
Avail: NTIS MF A01; print copy available at WMO, Geneva

N86-29461# Museum of Natural History, Los Angeles, Calif.
THE ROLE OF CENTRAL PACIFIC SEABIRDS IN PREDICTING THE 1982-83 ENSO
Ralph W. Schreiber and Elizabeth Anne Schreiber *In* WMO International Conference on the TOGA Scientific Program Sep. 1985 6 p (For primary document see N86-29441 20-47)
(Grants NSF OCE-83-08756; NSF OCE-84-04152; NGS-265783)
Avail: NTIS MF A01; print copy available at WMO, Geneva

51 LIFE SCIENCES (GENERAL)

Includes genetics.

N86-29494# General Accounting Office, Washington, D. C.
BIOTECHNOLOGY: THE US DEPARTMENT OF AGRICULTURE'S

BIOTECHNOLOGY RESEARCH EFFORTS
Oct. 1985 80 p
(GAO/RCED-86-39BR) Avail: NTIS HC A05/MF A01

Topics discussed include: United States Department of Agriculture biotechnology research efforts; funding; accomplishments; institutions receiving grants; and the state experimental stations and colleges of veterinary science. Author

52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and weightlessness.

N86-29495*# Stanford Univ., Calif. Div. of Cardiology.
EFFECTS OF SIMULATED WEIGHTLESSNESS ON REGIONAL BLOOD FLOW SPECIFICALLY DURING CARDIOVASCULAR STRESS Final Report
Donald C. Harrison 1986 15 p
(Contract NCC2-126)
(NASA-CR-177117; NAS 1.26:177117) Avail: NTIS HC A02/MF A01 CSCL 06S

Significant changes in the cardiovasular system of humans and animals have been observed following exposure to prolonged periods of weightlessness during space flight. Although adaption to weightlessness is relatively uncomplicated, marked changes in cardiovascular deconditioning become evident upon return to normal gravity, including orthostatic hypotension and tachycardia. Some evidence that myocardial degeneration occurs has been demonstrated in animals who have been immobilized for two months. Also, evidence of possible loss of myocardial mass following manned space flight has been obtained by means of echocardiographic studies. These findings have serious implications in light of the increasing frequency and duration of Space Shuttle missions and the prospect of extended space station missions in the future. A number of both military and civilian investigators, including middle-aged scientists, will probably encounter prolonged periods of weightlessness. It has been imperative, therefore, to determine the effects of prolonged weightlessness on cardiovascular deconditioning and whether such effects are cumulative or reversible. The research project conducted under NASA Cooperative Agreement NCC 2-126 was undertaken to determine the effects of prolonged simulated weightlessness on regional blood flow. Research results are reported in the three appended publications. Author

N86-29496*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SKELETAL RESPONSE TO SHORT-TERM WEIGHTLESSNESS Final Technical Report
Thomas J. Wronski and Emily R. Morey-Holton 1986 16 p
(Grant NCC2-337)
(NASA-TM-88778; NAS 1.15:88778) Avail: NTIS HC A02/MF A01 CSCL 06S

Male Sprague Dawley rats were placed in orbit for 7 days aboard the space shuttle. Bone histomorphometry was performed in the long bones and lumbar vertebrae of flight rats and compared to data derived from ground based control rats. Trabecular bone mass was not altered during the first week of weightlessness. Strong trends were observed in flight rats for decreased periosteal bone formation in the tibial diaphysis, reduced osteoblast size in the proximal tibia, and decreased osteoblast surface and number in the lumbar vertebra. Histologic indices of bone resorption was relatively normal in flight rats. The results indicate that 7 day of weightlessness are not of sufficient duration to induce histologicaly detectable loss of trabecular bone in rats. However, cortical and trabecular bone formation appear to be diminished during the first week of space flight. Author

N86-29497*# California Univ., San Diego.
CARDIAC RESERVE DURING WEIGHTLESSNESS SIMULATION AND SHUTTLE FLIGHT Final Report, 15 Oct. 1984 - 14 Oct. 1985
Ary L. Goldberger Oct. 1985 32 p
(Grant NCC2-335)
(NASA-CR-177085; NAS 1.26:177085; LR-7552) Avail: NTIS HC A03/MF A01 CSCL 06S

Bedrest deconditioning is suspected to reduce cardiac function. However, quantitation of subtle decreases in cardiac reserve may be difficult. Normal subjects show considerable variability in heart rate response, reflected by a relatively broadband interbeat interval power spectrum. We hypothesized that the deconditioning effects of bedrest would induce narrowing of this spectrum, reflecting a reduction in the autonomically-modulated variability in heart rate. Ten aerobically conditioned men (average 35-50 years) underwent orthostatic tolerance testing with lower body negative pressure pre-bedrest and after 10 days of bedrest, while on placebo and after intravenous atropine. Spectra were derived by Fourier analysis of 128 interbeat interval data sets from subjects with sufficient numbers of beats during matched periods of the protocol. Data suggest that atropine unmasks the deconditioning effect of bedrest in athletic men, evidenced by a reduction in interbeat interval spectral power compared with placebo. Spectral analysis offers a new means of quantitating the effects of bedrest deconditioning and autonomic perturbations on cardiac dynamics. Author

N86-29498*# Vanderbilt Univ., Nashville, Tenn. School of Medicine.
WEIGHTLESSNESS SIMULATION: PHYSIOLOGICAL CHANGES IN FAST AND SLOW MUSCLE Final Technical Report, 1 Jun. 1984 - 31 May 1985
Wolf-D. Dettbarn 31 May 1985 22 p
(Grant NAG2-301)
(NASA-CR-176945; NAS 1.26:176945) Avail: NTIS HC A02/MF A01 CSCL 06P

The role of the intact motor system in the maintenance of normal skeletal muscle structure and function were examined. Using a multidisciplinary approach, changes in slow and fast muscle were examined in response to three experimental paradigms: motor nerve denervation, spinal cord section, and nonsurgically induced disuse (or hypokinesia). The effects of use and disuse on the free radical scavenging system in relation to the mitochondrial oxidative metabolism in fast twitch and slow twitch muscle were also investigated. The effects of denervation and reinnervation on cuprozinc superoxide dismutase, manganosuperoxide dismutase, glutathione peroxidase, fumarase, cytochrome c oxidase, and GSH-peroxidase were studied. Changes in biochemical, histochemical, and physiological characteristics of the predominately slow (type 1) soleus and predominately fast (type 2) extensor digitorum longus are correlated with electromyogram assessment of muscle activation. B.G.

N86-29499# Sea-Space Research Co., Inc., Harvey, La.
EVALUATION OF THE USE OF HYDROGEN-OXYGEN AS A BREATHING GAS IN DEEP-SEA DIVING
Peter Edel 1986 31 p
(Contract N00014-85-C-0592)
(AD-A165797) Avail: NTIS HC A03/MF A01 CSCL 06/11

An attempt is made to define the state-of-the-art for the use of Hydrogen-Oxygen mixtures for diving operations. Information relative to past and current research efforts in the U.S. and foreign countries is compiled. This information is utilized to identify possible areas of application with this mixture in appropriate conditions and in areas in which hydrogen-oxygen mixtures could offer physiological advantages not possible with currently used breathing mixtures. Further research is needed prior to operational use of this mixture, and recommendations for current and future research and development needs are included in this report. Hydrogen-oxygen mixtures have shown sufficient advantage to warrant further research. Present experience indicates that H2-02 mixtures offer some potential advantages over present helium-oxygen bounce

diving applications for operations where on-site gas storage space is limited and/or resupply of breathing gas mixtures are a potential problem. Present experience indicates that H2-He-02 mixtures offer some potential advantages over present helium-oxygen saturation diving operations at depths where increased diver performance and reduction of breathing resistance is an important factor. Hydrogen narcosis effects and decompression requirements are the major primary physiological research areas requiring investigation prior to possible applications of such mixtures. GRA

N86-29500# Research Inst. of National Defence, Umea (Sweden). Dept. 4.
METHOD FOR THE DETERMINATION OF RESPIRATORY WORK IN PROTECTIVE MASKS
Iage Berglund and Kenneth Nyren Jun. 1985 27 p In SWEDISH; ENGLISH summary
(FOA-C-40213-C2; ISSN-0347-2124; ESA-86-97042) Avail: NTIS HC A03/MF A01; Research Inst. of National Defence, Stockholm, Sweden KR 50

A method for estimating respiratory work by measuring flow and pressure in a protective mask on a dummy head, during inhalation and exhalation, with a respiratory pump is described. Data acquisition, evaluation, and graphical presentation for a respiratory cycle are performed with a laboratory computer. Malfunction of the inlet valve may lead to leakage so that expired air wrongly passes through the filter. Actually the user of the mask would compensate for this by increasing the respired volume, thus increasing the respiratory work. In the described method this leakage indicates, on the contrary, lower respiratory workload. ESA

N86-29501# Chicago Univ., Ill. Dept. of Radiology.
MTF's AND WIENER SPECTRA OF RADIOGRAPHIC SCREEN-FILM SYSTEMS. VOLUME 2: (INCLUDING SPEEDS OF SCREENS, FILMS AND SCREEN-FILM SYSTEMS)
K. Doi, Y. Kodera, L. N. Loo, H. P. Chan, and Y. Higashida Mar. 1986 110 p Sponsored by FDA
(Contracts PHS-223-78-6003; PHS-223-81-6014)
(PB86-184934; HHS/PUB/FDA-86-8257-Vol-2; FDA/CDRH-86/103-Vol-2) Avail: NTIS HC A06/MF A01 CSCL 06E

Volumes I and II of the report constitute a consistent, quantitative evaluation of the physical imaging performance of most currently available radiographic screens and films. Volume I (HHS Publication FDA 82-8187, April 1982) reported measurements of MTF's and Wiener spectra of a large number of screen-film systems and described the methodology. Volume II reports measurement (using the same methodology) of MTF's and Wiener spectra of additional systems. Volume II also reports absolute speeds (determined according to ANSI Standard PH 2.43-1982) for selected systems and relative speeds for a large group of screens and films; methodology for these measurements is described in detail. GRA

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N86-29502*# Massachusetts Inst. of Tech., Cambridge. Man-Machine Systems Lab.
EFFECT OF TIME SPAN AND TASK LOAD ON PILOT MENTAL WORKLOAD
Scott L. Berg and Thomas B. Sheridan Mar. 1985 150 p
(Grant NAG2-227)
(NASA-CR-177099; NAS 1.26:177099) Avail: NTIS HC A07/MF A01 CSCL 05H

Two sets of experiments were run to examine how the mental workload of a pilot might be measured. The effects of continuous manual control activity versus discrete assigned mental tasks (including the length of time between receiving an assignment and executing it) were examined. The first experiment evaluated the strengths and weaknesses of measuring mental workload with an objective perforamance (altitude deviations) and five subjective ratings (activity level, complexity, difficulty, stress, and workload). The second set of experiments built upon the first set by increasing workload intensities and adding another performance measure: airspeed deviation. The results are discussed for both low and high experience pilots. B.G.

N86-29503*# California State Univ., Hayward. Dept. of Psychology.
HESITATIONS IN CONTINUOUS TRACKING INDUCED BY A CONCURRENT DISCRETE TASK
Stuart T. Klapp, Patricia A. Kelly, and Allan Netick 1985 40 p
(Contract NCC2-223)
(NASA-CR-177019; NAS 1.26:177019) Avail: NTIS HC A03/MF A01 CSCL 05I

Subjects performed a continuous visually-guided pursuit tracking task with the right hand. From time to time (intervals averaging 30 sec) an auditory tone appeared signaling the subjects to perform a discrete response with the left hand. The presence of this tone was frequently associated with a hesitation in right-hand tracking which lasted 1/3 sec or longer. The rate of occurrence of these hesitations was about the same when the left-hand response involved a choice between competing responses as when the left hand responded in a predetermined direction. Hesitations occurred for three different mechanical tracking manipulanda using different controlling muscles, and appeared to be due to freezing rather than to relaxation of muscular action. The rate of occurrence of hesitations declined with practice, and this improvement in right-hand performance was accompanied by an improvement in performance of the concurrent left-hand response. The presence of hesitations, and their reduction with practice, can be interpreted within several viewpoints. Author

N86-29504*# California Univ., Los Angeles. School of Engineering and Applied Science.
MODEL-BASED APPROACHES FOR PARTITIONING SUBJECTIVE WORKLOAD ASSESSMENTS Final Technical Report
John Lyman Feb. 1986 19 p Presented at the Annual Conference of Manual Control, Jun. 1986
(Grant NAG2-216)
(NASA-CR-177030; NAS 1.26:177030) Avail: NTIS HC A02/MF A01 CSCL 05I

Modified Petri nets (MPNs) were investigated as a workload modeling tool. The MPN model was screened for general sensitivity to changes in workloads. A canonical correlation was conducted between the MPN parameters and the workload ratings. The results of the canonical correlation indicated that the MPN model of the experimental task represented the task components that influenced the subjective workload. B.G.

N86-29505*# Ohio State Univ., Columbus. Dept. of Aviation.
THE EFFECTS OF EXPRESSIVITY AND FLIGHT TASK ON COCKPIT COMMUNICATION AND RESOURCE MANAGEMENT Final Report, 1 Aug. 1982 - 31 Aug. 1985
R. S. Jensen Jun. 1986 95 p
(Contract NCC2-206; RF Proj. 76327/714794)
(NASA-CR-177036; NAS 1.26:177036; APL-86-1) Avail: NTIS HC A05/MF A01 CSCL 05I

The results of an investigation to develop a methodology for evaluating crew communication behavior on the flight deck and a flight simulator experiment to test the effects of crew member expressivity, as measured by the Personal Attributes Questionnarie, and flight task on crew communication and flight performance are discussed. A methodology for coding and assessing flight crew communication behavior as well as a model for predicting that behavior is advanced. Although not enough crews were found to provide valid statistical tests, the results of the study tend to indicate that crews in which the captain has high expressivity perform better than those whose captain is low in expressivity. There appears to be a strong interaction between captains and first

officers along the level of command dimension of communication. The PAQ appears to identify those pilots who offer disagreements and inititate new subjects for discussion. Author

N86-29506# Research Inst. of National Defence, Stockholm (Sweden). Dept. 5.
RAPID MEASUREMENT OF INDIVIDUAL STRESS REACTION LEVEL: DEVELOPMENT OF THE EMOTIONAL REACTION QUESTIONNAIRE (ESRQ)
Gerry Larsson Jan. 1986 33 p In SWEDISH; ENGLISH summary
(FOA-C-50034-H3; ISSN-0347-7665; ESA-86-97044) Avail: NTIS HC A03/MF A01

A questionnaire which estimates the magnitude of the stress reaction of an individual in a given situation in less than a minute is described. Psychological coping potential can also be predicted. Derivation of the questionnaire from coping theory is outlined. The process of instrument development is described and instructions for usage and interpretation of the questionnaire are given. Normative data as well as assessments of reliability and validity are presented. ESA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

N86-29507*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
SHOULDER AND HIP JOINTS FOR HARD SPACE SUITS AND THE LIKE Patent
Hubert C. Vykukal Issued 8 Jul. 1986 12 p Filed 20 Aug. 1984 Supersedes N84-33021 (22 - 22, p 3633)
(NASA-Case-ARC-11534-1; US-Patent-4,598,428; US-Patent-Appl-SN-642602; US-Patent-Class-2-2.1A; US-Patent-Class-285-168; US-Patent-Class-285-184; US-Patent-Class-285-227; US-Patent-Class-138-120; US-Patent-403-164) Avail: US Patent and Trademark Office CSCL 06Q

For use in hard space suits and the like, a joint between the torso covering and the upper arm covering (i.e., shoulder) or between the torso covering and upper leg covering (i.e., hip) is disclosed. Each joint has an outer covering and a inner covering. The outer covering has plural perferably truncated toroidal sections decreasing in size proceeding outwardly. In one embodiment at each joint there are two bearings, the first larger than the second. The outer race of the larger bearing is attached to the outer edge of the smaller end of each section and the inner race of the larger bearing is attached to the end wall. The inner race of the smaller bearing is attached to the end wall. The outer race of the smaller bearing is attached to the larger end of the next section. Each bearing hask appropriate seals. Between each section is a rubber ring for the comfort of the wearer. Such rubber rings have radial flanges attached to the inner races of two adjacent bearings. Matching semicircular grooves are formed in the abutting overlapping surfaces. Bellows-like inner walls are also provided for each section fixed at one end to an inner cylindrical flange and, at the opposite end, to an end wall. Each outer section may rotate 360 deg relative to the next outer section, whereas the bellows sections do not rotate, but rather expand or contract locally as the rigid sections rotate relative to each other. NASA

N86-29508*# Georgia Inst. of Tech., Atlanta. Center for Man-Machine Systems Research.
PILOT INTERACTION WITH AUTOMATED AIRBORNE DECISION MAKING SYSTEMS Semiannual Progress Report, Mar. - Aug. 1984
William B. Rouse, John M. Hammer, Nancy M. Morris, Annette E. Knaeuper, Edward N. Brown, Charles M. Lewis, and Wan C. Yoon Aug. 1984 45 p
(Grant NAG2-123)
(NASA-CR-177002; NAS 1.26:177002) Avail: NTIS HC A03/MF A01 CSCL 05H

Two project areas were pursued: the intelligent cockpit and human problem solving. The first area involves an investigation of the use of advanced software engineering methods to aid aircraft crews in procedure selection and execution. The second area is focused on human problem solving in dynamic environments, particulary in terms of identification of rule-based models land alternative approaches to training and aiding. Progress in each area is discussed. B.G.

N86-29509*# Massachusetts Inst. of Tech., Cambridge. Dept. of Nutrition and Food Science.
EFFECTS OF CONSUMING VARIOUS FOODS AND NUTRIENTS ON OBJECTIVE AND SUBJECTIVE ASPECTS OF HUMAN PERFORMANCE AND BEHAVIOR Final Report, 1 Sep. 1983 - 31 Aug. 1984
Richard J. Wurtman and Harris R. Lieberman 31 Aug. 1984 10 p
(Grant NAG2-132)
(NASA-CR-177003; NAS 1.26:177003) Avail: NTIS HC A02/MF A01 CSCL 06H

A variety of behavioral tests were established and studies performed on young healthy subjects who received tryptophan, tyrosine or placeboes and on young and old subjects receiving protein and carbohydrate meals. The behavioral effect of the homone melatonin on human circadian rhythms was examined. The results are discussed. B.G.

N86-29510# Naval Ship Research and Development Center, Bethesda, Md. Computation Mathematics and Logistics Dept.
THE SCIENTIFIC/ENGINEERING WORKSTATION EXPERIMENT: PRELIMINARY RESULTS, CONCLUSIONS AND RECOMMENDATIONS Progress Report, Apr. - Aug. 1984
Richard T. VanEseltine and Mary B. Marquardt Dec. 1985 35 p
(AD-A163059; DTNSRDC/CMLD-85/05) Avail: NTIS HC A03/MF A01 CSCL 05/9

A Scientific/Engineering Workstation Experiment is being conducted to determine the characteristics of workstations which would significantly improve the productivity of scientists and engineers in the Naval Laboratories. This report discusses the evaluation methodology and results. Furthermore, the report presents preliminary comments and recommendations for scientific-/engineering workstation specifications. The initial results of the experiment are based on the time interval from April to August, 1984. Four major preliminary conclusions were reached. First, workstations can be effectively used for real projects. Second, the individual scientists or engineer's working environment plays an important role in the utilization of a workstation. Third, certain features and capabilities were found to be used by scientists and engineers on certain features and capabilities were found to be used by scientists and engineers on almost all workstations. Finally, workstation specifications should be primarily based on performance requirements that insure the actual needs of scientists and engineers are met. GRA

N86-29511# Research Inst. of National Defence, Stockholm (Sweden). Dept. 5.
ANTHROPOMETRY RESEARCH PROGRAM
Anita Aven, Sven Dahlman, and Lena Sperling Dec. 1985 51 p In SWEDISH; ENGLISH summary Sponsored by Swedish Work Environment Fund
(FOA-C-50032-H2; ISSN-0347-7665; ESA-86-97043) Avail: NTIS HC A04/MF A01

Swedish anthropometry investigations; collecting data on stature and body weight of people in Sweden; methods for comparing the body dimensions of different groups of people; and the use of anthropometry when designing equipment and enviroments were discussed. ESA

N86-29512# Centre d'Essais en Vol, Istres (France). Lab. de Medecine Aerospatiale.

THE CHOICE OF SEAT BACK ANGLE TO IMPROVE ACCELERATION TOLERANCE

J. M. Clere, H. Vieillefond, and J. L. Poirier Oct. 1985 51 p (Contract DRET-82-1131)
(CEV-70-209; ESA-86-97195) Avail: NTIS HC A04/MF A01

The optimization of pilot seat back angle at accelerations of 7.8 to 9 g was studied using centrifugal simulation facilities. The physiological parameters such as heart rate, blood pressure, and visual field were measured at seat back angles from 30 to 60 deg. It is shown that the seat back angle of 60 deg eliminates visual problems at 9 g and protects against blood circulation problems. Angles of 30 deg produce clear intolerance symptoms. ESA

N86-29513*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

SPACE TELEOPERATION RESEARCH. AMERICAN NUCLEAR SOCIETY EXECUTIVE CONFERENCE: REMOTE OPERATIONS AND ROBOTICS IN THE NUCLEAR INDUSTRY; REMOTE MAINTENANCE IN OTHER HOSTILE ENVIRONMENTS

A. J. Meintel, Jr. and R. W. Will 1985 51 p Presented at the Executive Conference on Remote Operations and Robotics in the Nuclear Industry, Pine Mountain, Ga., 21 Apr. 1985
(NASA-TM-89234; NAS 1.15:89234; DE85-902186; CONF-850425-5) Avail: NTIS HC A04/MF A01 CSCL 05H

This presentation consists of four sections. The first section is a brief introduction to the NASA Space Program. The second portion summarized the results of a congressionally mandated study of automation and robotics for space station. The third portion presents a number of concepts for space teleoperator systems. The remainder of the presentation describes Langley Research Center's teleoperator/robotic research to support remote space operations. DOE

55 PLANETARY BIOLOGY

Includes exobiology; and extraterrestrial life.

N86-29514# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Flugmedizin.

PROCEEDINGS AND PROGRAM DRAFT IN GRAVITATIONAL BIOLOGY IN THE FEDERAL REPUBLIC OF GERMANY

Oct. 1985 194 p In GERMAN; ENGLISH summary Conference held in Cologne, West Germany, 14-15 Jun. 1985 Report will also be announced as translation (ESA-TT-988)
(DFVLR-Mitt-85-16; ISSN-0176-7739; ESA-86-96885) Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

The effects of weightlessness on animal organisms to better understand effects on human body during space flights are discussed. Investigations on vertebrate physiology, reproduction, genetics, neurobiology, and behavioral and motion physiology are proposed. For individual titles, see N86-29515 through N86-29532.

N86-29515# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Bereich fuer Projekttraegerschaften.

THE ROLE OF THE DFVLR PROJECT MANAGEMENT LIFE SCIENCES IN THE SPACE PROGRAM OF THE FEDERAL REPUBLIC OF GERMANY

Ferdinand Dahl *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) Oct. 1985 p 9-20 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

The German space program in cooperation with ESA and NASA is focussed on Spacelab 1 mission, on Eureca mission, the Long Duration Exposure Facility, the International Microgravity Laboratory, Spacelab D2 mission, as well as on bioracks, European Radiation Assembly and Human Physiology Laboratory. Experiments are carried out in radiobiology, exobiology, physiology, botany, microbiology, rhythmic processes, and biotechnology. The DFVLR project management and the experiment/project selection procedure by scientific advisory committees are presented. ESA

N86-29516# Stuttgart Univ. (West Germany). Abt. Bioenergetik.

A THEORETICAL CONCEPT FOR STATE CHANGES AND SHAPE CHANGES IN WEIGHTLESSNESS

Reto J. Strasser *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) Oct. 1985 p 23-31 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

A theoretical concept for state and shape changes in weightlessness based on thermodynamics principles for open systems is developed. The influence of light, temperature, pressure, and gravity on the shape and state of a biological system, and therefore on the phenotype with steady genome are studied. Experiments are carried out on leaves, chloroplasts, neurospores and mammalian cell spheroids. An experimental module for cellular biology was built for automatic optical and electrode measurements. The data are recorded, stored, and processed at a ground station. Experiments in space stations are recommended to study the influence of gravity and geomagnetism on the shape and the biochemical processes of a biological system and to obtain data on the phylogenesis of more complicated organisms. ESA

N86-29517# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany). Inst. fuer Flugmedizin.

SOME REMARKS ON GRAVITATIONAL BIOLOGY

Wolfgang Briegleb *In its* Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) Oct. 1985 p 33-44 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

A functional system including direct/primary, indirect/secondary and various indirect/tertiary interactions between an organism and gravity was developed to study the genetic and phylogenic consequences of gravity on animals living in water or on land. Gravity influences the gravity receptors leading to humoral or neuronal responses according to cell or proprioreceptor excitation. The immersed condition with no indirect gravity influence is compared with real weightlessness to analyze gravity direct influence on an isolated cell function or on a bunch of cells in egg ontogenesis and to analyze the effects of gravity on statocyst differentiation. In animals living on land, the antigravity structures and functions are influenced by gravity. The mutational effects of gravity leading to gene evolution through neuronal and functional morphological responses are presented. Hypergravity and weightlessness should be further studied. ESA

N86-29518# Konstanz Univ. (West Germany). Biologische Fakultaet.

INVESTIGATIONS OF PARAMECIUM CELLS ANALYZED UNDER MICROGRAVITY CONDITIONS

Helmut Plattner *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVLR-Mitt-85-16) Oct. 1985 p 47-52 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

Paramecium tetraurelia cells were studied using light microscopy, video recording, amino-ethyl dextran as redocking trigger agent and electronic microscopy to analyze exocytosis movements, redocking cycles on the cellular membrane and trichocyst building-up for 12 hr. The relationship between trichocyst ejection and motion behavior under microgravity conditions is studied using behavior mutants and secretion mutants to assess the negative or positive selection pressure of trichocyst presence or absence. ESA

N86-29519# Bonn Univ. (West Germany). Zoologisches Inst.

THE ORIGIN OF THE SPICULE SKELETON OF FRESH WATER SPONGES (SPONGILLIDES)

Norbert Weissenfels *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 53-56 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

Young fresh water sponges cultivated in laboratory in constant temperate water and in ambient temperature were used to study the origin of the sponge spicule skeleton. The SiO2 spicules are formed in scleroblasts. Aged spicules leave the scleroblasts and are transported by transport cells to their functional location where they adhere to the base plate through epongin which ensures their stability. The life cycle of the spongillides throughout the seasons is described. The influence of gravity on the development of young sponges should be studied. ESA

N86-29520# Cologne Univ. (West Germany). Zoologisches Inst.
LIMB REGENERATION IN AMPHIBIANS, A SUITABLE MODEL FOR INVESTIGATIONS OF THE EFFECTS OF WEIGHTLESSNESS AS REGARDS EVOLUTION AND MODIFICATIONS
Hermann Josef Anton *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 63-68 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

Limb regeneration in urodeles, amphibians which have experienced a phylogenetic evolution to overcome the effects of gravity, was studied to analyze the long term effects of weightlessness depending on environmental conditions and on gene activation. The study gives data on evolution processes and phylogenesis under weightlessness, on calcium exchange, and physiological regeneration of the skeleton as supporting and moving apparatus. ESA

N86-29521# Ruhr Univ., Bochum (West Germany). Fakultaet fuer Biologie.
INVESTIGATIONS OF THE REPRODUCTIVE PHYSIOLOGY OF THE RAINBOW TROUT (SALMO GAIRDNERI RICHARDSON)
Volker Bluem and Ruediger Schulz *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 69-73 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

Morphological and endocrinal investigations on the reproductive physiology of the rainbow trout of either sex were performed to study hypothalamic production of gonadotropin releasing hormone (GnRH) using histological and histometrical analysis, to demonstrate the presence of gonadotrop hormone receptors (GTH-receptors) in testes and ovaries based on radioimmunological quantification and using the immunofluorescent technique. An in vitro system for gonad tissues was developed to study steroid genesis in short-time cultures. The effects of puberty in rainbow trout on material exchange are studied. Ethiological studies were carried out to determine the influence of sexual and/or parental phases. The morphological control of gametogenesis in micro-g environment is recommended as well as in vivo and in vitro investigations of reproduction-dependent hormonal systems. ESA

N86-29522# Essen Univ. (West Germany). Abt. fuer Zoophysiologie.
CHANGES IN THE MORPHOLOGICAL AND MOLECULAR BIOLOGICAL PROCESSES DURING EARLY EMBRYO DEVELOPMENT IN AMPHIBIANS UNDER MICRO G CONDITIONS
Horst Grunz *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 75-80 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

The effects of micro-g conditions on vegetative polarity (absence of change) in aging oocytes over 2 months were studied to determine the role of gene regulatory factors and the changes in nucleus-cytoplasm interactions. Cell affinity and induction should be investigated under micro-g conditions to study the processes of reaggregation between ectoderm and endoderm and the changes in the standard structure so as to understand normal and pathological embryo development. ESA

N86-29523# Giessen Univ. (West Germany). Genetischen Inst.
XIPHOPHORUS: A SYSTEM TO RECOGNIZE RADIATION-INDUCED MUTATIONS AND TO STUDY THE EFFECTS OF ZERO-GRAVITY ENVIRONMENT ON EMBRYO DEVELOPMENT
Carl-Rudolf Schmidt and Fritz Anders *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 81-85 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

The reproduction physiology of Xiphophorus is described. Laboratory mutants constitute a system of 60 stable and genetically determined species. Resulting from their crossbreeding melanomas appear due to a disorded oncogene. The Xiphophorus system is studied to determine the oncogene characteristics, regulation and transmission. Studies on Xiphophorus under weightlessness are recommended: influence of 0-g environment on skeleton and skeletonmuscle structure; epigenetic and/or genetic effects of 0-g environment on embryogenesis in vivo and in vitro; and the effects of the combined action of cosmic radiation and weightlessness on embryos, sub-adult and adult animals of the mutation-sensitive Xiphophurus test species to investigate mutagenesis and teratogenesis. ESA

N86-29524# Luebeck Univ. (West Germany). Inst. fuer Physiologie.
HYPOXIC HYPOXIA AS A STIMULUS OF ERYTHROPOIESIS IN VIVO AND IN VITRO
Wolfgang Jelkmann *In* DFVLR Proceedings and program draft in Gravitational Biology in the Federal Republic of Germany Oct. 1985 p 95-100 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

The action of weightlessness on red blood volume in astronaut's anemia and on erythropoiesis leading to increased hemolysis is studied. Several generations of mice and rats bred in weightlessness were studied to determine the effects of weightlessness on the erythropoetic tissues, on erythropoiesis and on calcification. Causes of astronaut's anemia are listed. The effects of weightlessness on the erythropoietic system ontogenesis were measured based on circulative blood and erythrocyte volumes, the functional integrity of the hematopoietic tissue and the capacity of the erythropoietic system to react to hypoxia. ESA

N86-29525# Marburg Univ. (West Germany). Arbeitsgruppe Verhaltensphysiologie.
A LEARNING MODEL AS A BASIS FOR INVESTIGATIONS OF THE EFFECTS OF GRAVITY ON THE LEARNING PROCESSES AND MEMORY FORMULATION
Christiane Buchholtz *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 107-113 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

The effects of gravity on learning strategy were studied using conditioned mice and a data acquisition computer system recording the daily performance of each mouse. The records are used to develop learning models. Increased gravity causes changes in the functional relationship between data storage units. These changes depend on the calculation result of proprioceptive feedbacks, and on time dependent effects represented by transmission of data from a short term memory related to the biophysical phase to long term memory related to the biochemical phase. ESA

N86-29526# Duesseldorf Univ. (West Germany). Inst. fuer Physikalische Biologie.
LONG-TERM ADAPTATION OF THE OTOLITH ORGANS
Rolf Eckmiller *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 115-120 In GERMAN; ENGLISH

summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

Reduction in sensitivity of otolith organs in primates before a space mission and methods to reduce it were investigated to avoid space motion sickness. A procedure should be developed under neurophysiological control of the otolith afferences to influence the size and location of otoconia. ESA

N86-29527# Ulm Univ. (West Germany). Abt. Neurologie.
FUNCTIONAL DEVELOPMENT OF GRAVITY RECEPTORS IN INSECTS AND AMPHIBIANS
Eberhard Horn *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 121-128 In GERMAN; ENGLISH summary Sponsored by Deutsche Forschungsgeimschaft (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

Insects using a proprioceptive system and amphibians using a statocyst system were studied to analyze the functional development of a sensory system and its influence of the body muscle structure. The effects of micro-g through gravity receptors on the efficiency of the sensory system, on the adaptative mechanisms of the neuronal development under changing living conditions or under the animal pathological conditions, and on the hormonal environment are studied. The studies are based on eye reflex (Xenopus) and head reflex (Gryllus) and on equilibrium observations. ESA

N86-29528# Stuttgart Univ. (West Germany). Inst. fuer Zoologie.
FUNCTION-DEPENDENT PLASTICITY IN THE NERVOUS SYSTEM
Hinrich Rahmann and Wolfgang Probst *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 135-139 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

The tectum opticum of fish midbrain is studied to demonstrate the involvement of gangliosides in the functional plastic changes in synaptic systems and in visual acuity. The structural synaptic plasticity after light variations involving synaptic vesicles and after temperature variations involving the nervous system are studied using differential quantitative light and electronic microscopes. The biochemical neuronal plasticity after temperature variations involves sialo-glycoconjugate bonds and gangliosides. The molecule basic properties are determined using the monolayer technique for physico-chemical in vitro experiments with various neuronal membrane lipids combined with calcium ions. Further investigations are recommended to study neuronal plasticity in reduced or in absence of gravity. ESA

N86-29529# Bonn Univ. (West Germany). Zoologisches Inst.
MORPHOLOGY AND DEVELOPMENT OF THE INNER EAR OF ANURANS
Hans Schneider and Iris Hertwig *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 141-146 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

The Anuran inner ear consists of five sensory sections for orientation in space and perception of acoustic signals. Utriculus, sacculus and lagena are gravity receptors possessing otoliths. The ampullae of the semicircular canals are responsible for rotation sense. Papillia basilaris and papilla amphiborum allow respectively perception of high frequencies and low frequencies. The development of the labyrinth in amphibians begins after neurulation. The receptors consist of sensory cells and support cells. Experiments in simulated weightlessness show that the development of sensory epithelia and otoliths do not depend on gravity and should be confirmed by experiments in space. ESA

N86-29530# Bielefeld Univ. (West Germany). Abt. Neuroanatomie.
QUESTIONS ON THE EVOLUTION OF THE DEVELOPMENTAL PROGRAM OF THE VERTEBRATE INNER EAR UNDER LONG TERM ZERO G CONDITIONS
Bernd Fritzsch *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 151-156 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

The long-term effects of weightlessness on the formation and function of the vestibular system are studied with particular focus on the persistence of motion defects of larva up to adult age, on the reproduction function, on the adaptation or selection of the offspring and hybrids resulting from successful reproduction under weightlessness, and on the sensory epithelium differentiation. The structural changes of the inner ear in adapted or selected offspring are studied using electronic microscope and the afferent and efferent connections using tracer methods. High generation succession frequency and offspring number, applicable reproductive behavior and easy culture, and live food are the minimum requirements for program implementation. ESA

N86-29531# Kiel Univ. (West Germany). Inst. fuer Meereskunde.
LONG DURATION CONFINEMENT OF AQUATIC ORGANISMS IN WEIGHTLESSNESS (AQUASPACE)
Rainer Froese *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 159-164 In GERMAN; ENGLISH summary (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

A confinement facility resulting from the study of the transition phase between water and air was developed to study aquatic organisms in weightlessness. The facility is a closed system filled with water and consists of a central supply unit, confinement tanks, a lock system, a computer system for food supply control and measurement processing, videocameras monitoring growth, reproduction and behavior of the aquatic organisms, and two chambers to remove the gases released in water through a diffusion membrane and store oxygen in a gas mixture. The facility can be used to study the catabolism of the aquatic organisms in weightlessness and the effects of weightlessness and radiation on the reproduction biology. ESA

N86-29532# Ulm Univ. (West Germany). Abt. Neurologie.
PROGRAM DRAFT FOR A SPECIAL FIELD: GRAVITATIONAL BIOLOGY
Eberhard Horn *In* DFVLR Proceedings and Program Draft in Gravitational Biology in the Federal Republic of Germany (DFVL R-Mitt-85-16) Oct. 1985 p 173-189 In GERMAN (For primary document see N86-29514 20-55)
Avail: NTIS HC A09/MF A01; DFVLR, Cologne DM 50

Gravitational biology as a special field for fundamental research on organism biology in weightlessness is discussed. Cellular and molecular biology, genetics; reproduction and development biology; vegetative biology and matter exchange biology; neurobiology; behavioral and motion physiology; population genetics, and evolution biology, and ecology and life preservation systems are suitable fields of research. The cooperation between the different field specialists and experts can contribute to the knowledge of body stabilization and plasticity and adaptativity in weightlessness. ESA

N86-29533# Southwest Research Inst., San Antonio, Tex.
EFFECTS OF 60 Hz ELECTRIC FIELDS ON OPERANT AND SOCIAL STRESS BEHAVIOR OF NONHUMAN PRIMATES Quarterly Technical Progress Report, 28 Sep. - 20 Dec. 1985
W. R. Rogers 3 Jan. 1986 5 p
(Contract DE-AC02-80RA-50219)
(DE86-005067; DOE/RA-50219/T7; QTPR-20) Avail: NTIS HC A02/MF A01

This research program will evaluate the aversive character of

exposure to 60 Hz electric fields by determining the threshold intensity which produces avoidance or escape responses, will estimate the threshold intensity for detection of 60 Hz electric fields, will assess effects of chronic exposure to 60 Hz electric fields on the performance of two operant conditioning tasks, fixed ratio and differential reinforcement of low rate responding, will investigate, using the systematic quantitative observational sampling methods of primatology, the possible stress-inducing effects of chronic exposure to 60 Hz electric fields on the behavior of baboons living in small social groups. In all experiments, the electric fields will be described, characterized, and controlled to account for recognized artifacts associated with high intensity 60 Hz electric fields and the health of all subjects will be described using the methods of primate veterinary medicine. DOE

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes computer graphics and data processing.

For components see *33 Electronics and Electrical Engineering.*

N86-29534*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
IS RANDOM ACCESS MEMORY RANDOM?
Peter J. Denning 30 Jan. 1986 11 p Submitted for publication
(Contract NCC2-387)
(NASA-TM-89394; RIACS-TR-86.1; NAS 1.15:89394) Avail: NTIS HC A02/MF A01 CSCL 09B

Most software is contructed on the assumption that the programs and data are stored in random access memory (RAM). Physical limitations on the relative speeds of processor and memory elements lead to a variety of memory organizations that match processor addressing rate with memory service rate. These include interleaved and cached memory. A very high fraction of a processor's address requests can be satified from the cache without reference to the main memory. The cache requests information from main memory in blocks that can be transferred at the full memory speed. Programmers who organize algorithms for locality can realize the highest performance from these computers. Author

N86-29535*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PARALLEL STRUCTURES IN HUMAN AND COMPUTER MEMORY
Pentti Kanerva Jan. 1986 8 p Proposed for presentation at COGNITIVA 85, Paris, France Sponsored by System Development Foundation
(NASA-TM-89402; RIACS-TR-86.2; NAS 1.15:89402) Avail: NTIS HC A02/MF A01 CSCL 09B

If one thinks of our experiences as being recorded continuously on film, then human memory can be compared to a film library that is indexed by the contents of the film strips stored in it. Moreover, approximate retrieval cues suffice to retrieve information stored in this library. One recognizes a familiar person in a fuzzy photograph or a familiar tune played on a strange instrument. A computer memory that would allow a computer to recognize patterns and to recall sequences the way humans do is constructed. Such a memory is remarkably similiar in structure to a conventional computer memory and also to the neural circuits in the cortex of the cerebellum of the human brain. It is concluded that the frame problem of artificial intelligence could be solved by the use of such a memory if one were able to encode information about the world properly. Author

N86-29536*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
VIRTUAL MEMORY
Peter J. Denning 25 Mar. 1986 16 p
(Contract NCC2-387)
(NASA-TM-89401; RIACS-TR-86.8; NAS 1.15:89401) Avail: NTIS HC A02/MF A01 CSCL 09B

Virtual memory was conceived as a way to automate overlaying of program segments. Modern computers have very large main memories, but need automatic solutions to the relocation and protection problems. Virtual memory serves this need as well and is thus useful in computers of all sizes. The history of the idea is traced, showing how it has become a widespread, little noticed feature of computers today. Author

N86-29537# Manchester Univ. (England). Inst. of Science and Technology.
THE DEVELOPMENT OF DESIGN GUIDES FOR THE IMPLEMENTATION OF MULTIPROCESSING ELEMENT SYSTEMS Final Report, 1980 - 1984
D. Aspinall Sep. 1985 87 p
(Contract F49620-80-C-0012)
(AD-A163055; UMIST/RADC/1; RADC-TR-84-273) Avail: NTIS HC A05/MF A01 CSCL 09/2

Multi Processing-Element Systems are complex and it is important that designers have as much help as possible in arriving at an efficient and reliable design. The primary objective of the research project was to identify aspects of a design which could be investigated through simulation. Two aspects of the problem were identified. The first of these was the interconnection structure or system by which the separate processing elements are interconnected. The second concerned the language to be used in order to design the processes to be distributed throughout the Multi Processing-Element Systems. GRA

N86-29538# Stanford Univ., Calif.
HEURISTIC PROGRAMMING PROJECT Final Report, Oct. 1982 - Sep. 1985
Edward A. Feigenbaum and Bruce G. Buchanan 4 Mar. 1986 19 p
(Contract N00039-83-C-0136; ARPA Order 3423)
(AD-A165995) Avail: NTIS HC A02/MF A01 CSCL 09/2

This report summarizes basic and applied research into the science and engineering of knowledge-based systems. This work focused on five important and interrelated problems in building and using knowledge-based systems: 1) Basic Research in Knowledge-Based System Design and Implementation; 2) Intelligent Agents and tools for interacting with complex systems, planning, and cooperative problem solving; 3) The Blackboard Model and integration of knowledge from different sources; 4) Advanced Knowledge-based System Architectures for high performance parallel processing hardware and software; and 5) Knowledge-based VLSI tools for design and testing of integrated circuits. All of the research described in this report was performed within the Knowledge Systems Laboratory (KSL), formerly known as the Heuristic Programming Project (HPP). Sections 3 through 7 of this report summarize the KSL research under this contract. Publications resulting from this work contain the details of results and methodology, and are listed at the end of each section. Section 8 describes the computing environment of the KSL, the equipment purchases made under this contract, and the systems research and development that support the computing resources of the KSL. GRA

N86-29539# Lawrence Livermore National Lab., Calif.
EARLY MIMD EXPERIENCE WITH A PLASMA PHYSICS SIMULATION PROGRAM ON THE CRAY X-MP
C. E. Rhoades, Jr. Feb. 1986 16 p

(Contract W-7405-eng-48)
(DE86-006542; UCID-20656) Avail: NTIS HC A02/MF A01

This paper describes some early experience with converting a plasma physics simulation program to the CRAY- X-MP, a current multiple instruction, multiple data (MIMD) computer consisting of two processors with architecture similar to that of the CRAY-1. The computer program used in this study is an all Fortran version of SELF, a two species, one space, two velocity, electromagnetic, Newtonian, particle in cell, plasma simulation code. The approach to converting SELF to use both processors of the CRAY X-MP is described in some detail. The resulting multiprocessor version of SELF is nearly a factor of two faster in real time than the single processor version. The multiprocessor version obtains 58.2+ or -.1 seconds of central processor time in 30+ or -.5 seconds of real time. For comparison, the CRAY-1 execution time if 74.5 seconds. For SELF, which is mostly scalar coding, the CRAY X-MP is about 2.5 times faster overall than the CRAY-1. DOE

N86-29540# Argonne National Lab., Ill.
USING THE IBM 6670 INFORMATION DISTRIBUTOR AT ANL
A. Heiberger and R. Slade Feb. 1986 61 p
(Contract W-31-109-eng-38)
(DE86-008110; ANL/TM-434) Avail: NTIS HC A04

Using the IBM 6670 Information Distributor at the Argonne National Lab. tells you how to code files for the IBM 6670 Information Distributor and send those files to the IBM 6670 from CMS, Wylbur, VAX/VMS, or MVS batch. CMS users should find the detailed information on the recommended TYPE6670 option particularly helpful. The IBM 6670 Information Distributor is a laser page printer that can function as a computer printer, a word processing printer, and a communications device. DOE

N86-29541# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. d'Informatique.
REALIZATION OF EXCHANGE MODULES FOR SM90 MULTIPROCESSOR MACHINES Ph.D. Thesis [REALISATION DE MODULES D'ECHANGE DANS UNE MACHINE MULTIPROCESSOR LA SM 90]
Damien Lefort Jul. 1984 106 p In FRENCH
(ENST-84E020; ISSN-0751-1353; ESA-86-97208) Avail: NTIS HC A06/MF A01

The architecture and characteristics of the SM90 and the development of exchange modules are described. The SM90 is characterized by the Unix exploitation system written in Pascal language and Pascal compiler. The advantages of the 8086 microprocessor used for the exchange modules are discussed. Several exchange modules and their functional characteristics to assure the management of peripheral equipment are described. The possibility to evolve the machine using a 32 bit microprocessor is discussed. ESA

N86-29542# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. d'Informatique.
[ACTIVITIES REPORT OF THE COMPUTER SYSTEMS DEPARTMENT] Annual Report, 1984-1985 [RAPPORT D'ACTIVITES, 1984-1984: DEPARTEMENT INFORMATIQUE]
Oct. 1985 123 p In FRENCH
(ENST-85D004; ISSN-0751-1345; ESA-86-97210) Avail: NTIS HC A06/MF A01

Research in computer systems, computerized telecommunications, data analysis, operations research, artificial intelligence, and computer programming is summarized. ESA

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, and algorithms.

N86-29543*# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.
ALGORITHMS AND PROGRAMMING TOOLS FOR IMAGE PROCESSING ON THE MPP Report, May 1984 - Nov. 1985
Anthony P. Reeves Nov. 1985 160 p
(Grant NAG5-403)
(NASA-CR-177302; NAS 1.26:177302) Avail: NTIS HC A08/MF A01 CSCL 09B

Topics addressed include: data mapping and rotational algorithms for the Massively Parallel Processor (MPP); Parallel Pascal language; documentation for the Parallel Pascal Development system; and a description of the Parallel Pascal language used on the MPP. For individual titles, see N86-29544 through N86-29546.

N86-29544*# Cornell Univ., Ithaca, N.Y.
ALGORITHMS AND PROGRAMMING TOOLS FOR IMAGE PROCESSING ON THE MPP, INTRODUCTION Thesis
In its Algorithms and Programming Tools for Image Processing on the MPP Nov. 1985 —p 1-51 (For primary document see N86-29543 20-61)
Avail: NTIS HC A08/MF A01 CSCL 09B

The programming tools and parallel algorithms created for the Massively Parallel Processor (MPP) located at the NASA Goddard Space Center are discussed. A user-friendly environment for high level language parallel algorithm development was developed. The issues involved in implementing certain algorithms on the MPP were researched. The expected results were compared with the actual results. B.G.

N86-29545*# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.
ALGORITHMS AND PROGRAMMING TOOLS FOR IMAGE PROCESSING ON THE MPP. APPENDIX A: VMS COMMAND FILE USED TO IMPLEMENT pp COMMAND
In its Algorithms and Programming Tools for Image Processing on the MPP Nov. 1985 p 52-57 (For primary document see N86-29543 20-61)
Avail: NTIS HC A08/MF A01 CSCL 09B

A detailed description of the data mapping and rotation algorithms for the Massively Parallel Processor is given. B.G.

N86-29546*# Cornell Univ., Ithaca, N.Y. School of Electrical Engineering.
APPENDIX E: PARALLEL PASCAL DEVELOPMENT SYSTEM
In its Algorithms and Programming Tools for Image Processing on the MPP Nov. 1985 54 p (For primary document see N86-29543 20-61)
Avail: NTIS HC A08/MF A01 CSCL 09B

The Parallel Pascal Development System enables Parallel Pascal programs to be developed and tested on a conventional computer. It consists of several system programs, including a Parallel Pascal to standard Pascal translator, and a library of Parallel Pascal subprograms. The library includes subprograms for using Parallel Pascal on a parallel system with a fixed degree of parallelism, such as the Massively Parallel Processor, to conveniently manipulate arrays which have dimensions than the hardware. Programs can be conveninetly tested with small sized arrays on the conventional computer before attempting to run on a parallel system. Author

N86-29547*# Research Triangle Inst., Research Triangle Park, N.C.
AN EXPERIMENT IN SOFTWARE RELIABILITY Final Report
Janet R. Dunham and John L. Pierce May 1986 62 p
(Contract NAS1-16489)
(NASA-CR-172553; NAS 1.26:172553; Rept-412U-2094-12; Rept-412U-2094-14) Avail: NTIS HC A04/MF A01 CSCL 09B

The results of a software reliability experiment conducted in a controlled laboratory setting are reported. The experiment was undertaken to gather data on software failures and is one in a series of experiments being pursued by the Fault Tolerant Systems Branch of NASA Langley Research Center to find a means of credibly performing reliability evaluations of flight control software. The experiment tests a small sample of implementations of radar tracking software having ultra-reliability requirements and uses

n-version programming for error detection, and repetitive run modeling for failure and fault rate estimation. The experiment results agree with those of Nagel and Skrivan in that the program error rates suggest an approximate log-linear pattern and the individual faults occurred with significantly different error rates. Additional analysis of the experimental data raises new questions concerning the phenomenon of interacting faults. This phenomenon may provide one explanation for software reliability decay. M.G.

N86-29548*# Texas Technological Univ., Lubbock.
A SIMPLE ALGORITHM FOR COMPUTING CANONICAL FORMS
H. Ford, L. R. Hunt, and S. Renjeng 1986 27 p
(Grants NAG2-189; NAG2-203; Contract N0014-76-C1136)
(NASA-CR-177105; NAS 1.26:177105) Avail: NTIS HC A03/MF A01 CSCL 09B

It is well known that all linear time-invariant controllable systems can be transformed to Brunovsky canonical form by a transformation consisting only of coordinate changes and linear feedback. However, the actual procedures for doing this have tended to be overly complex. The technique introduced here is envisioned as an on-line procedure and is inspired by George Meyer's tangent model for nonlinear systems. The process utilizes Meyer's block triangular form as an intermedicate step in going to Brunovsky form. The method also involves orthogonal matrices, thus eliminating the need for the computation of matrix inverses. In addition, the Kronecker indices can be computed as a by-product of this transformation so it is necessary to know them in advance. Author

N86-29549*# California Univ., Los Angeles. Dept. of Electrical Engineering.
A SURVEY OF THE STATE OF THE ART AND FOCUSED RESEARCH IN RANGE SYSTEMS, TASK 2 Semiannual Report
Kung Yao Jan. 1986 27 p
(Grant NAG2-304)
(NASA-CR-177034; NAS 1.26:177034) Avail: NTIS HC A03/MF A01 CSCL 09B

Many communication, control, and information processing subsystems are modeled by linear systems incorporating tapped delay lines (TDL). Such optimized subsystems result in full precision multiplications in the TDL. In order to reduce complexity and cost in a microprocessor implementation, these multiplications can be replaced by single-shift instructions which are equivalent to powers of two multiplications. Since, in general, the obvious operation of rounding the infinite precision TDL coefficients to the nearest powers of two usually yield quite poor system performance, the optimum powers of two coefficient solution was considered. Detailed explanations on the use of branch-and-bound algorithms for finding the optimum powers of two solutions are given. Specific demonstration of this methodology to the design of a linear data equalizer and its implementation in assembly language on a 8080 microprocessor with a 12 bit A/D converter are reported. This simple microprocessor implementation with optimized TDL coefficients achieves a system performance comparable to the optimum linear equalization with full precision multiplications for an input data rate of 300 baud. The philosophy demonstrated in this implementation is dully applicable to many other microprocessor controlled information processing systems. Author

N86-29550*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
APPROXIMATE ALGORITHMS FOR PARTITIONING AND ASSIGNMENT PROBLEMS
M. Ashraf Iqbal Jun. 1986 31 p
(Contracts NAS1-17070; NAS1-18107)
(NASA-CR-178130; ICASE-86-40; NAS 1.26:178130) Avail: NTIS HC A03/MF A01 CSCL 09B

The problem of optimally assigning the modules of a parallel/pipelined program over the processors of a multiple computer system under certain restrictions on the interconnection structure of the program as well as the multiple computer system was considered. For a variety of such programs it is possible to find linear time if a partition of the program exists in which the load on any processor is within a certain bound. This method, when combined with a binary search over a finite range, provides an approximate solution to the partitioning problem. The specific problems considered were: a chain structured parallel program over a chain-like computer system, multiple chain-like programs over a host-satellite system, and a tree structured parallel program over a host-satellite system. For a problem with m modules and n processors, the complexity of the algorithm is no worse than O(mnlog(W sub T/epsilon)), where W sub T is the cost of assigning all modules to one processor and epsilon the desired accuracy. Author

N86-29551*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
STATISTICAL METHODOLOGIES FOR THE CONTROL OF DYNAMIC REMAPPING Final Report
Joel H. Saltz and David M. Nicol Jul. 1986 38 p Submitted for publication
(Contract NAS1-18107)
(NASA-CR-178129; ICASE-86-46; NAS 1.26:178129) Avail: NTIS HC A03/MF A01 CSCL 09B

Following an initial mapping of a problem onto a multiprocessor machine or computer network, system performance often deteriorates with time. In order to maintain high performance, it may be necessary to remap the problem. The decision to remap must take into account measurements of performance deterioration, the cost of remapping, and the estimated benefits achieved by remapping. We examine the tradeoff between the costs and the benefits of remapping two qualitatively different kinds of problems. One problem assumes that performance deteriorates gradually, the other assumes that performance deteriorates suddenly. We consider a variety of policies for governing when to remap. In order to evaluate these policies, statistical models of problem behaviors are developed. Simulation results are presented which compare simple policies with computationally expensive optimal decision policies; these results demonstrate that for each problem type, the proposed simple policies are effective and robust. Author

N86-29552*# Illinois Inst. of Tech., Chicago. Dept. of Electrical and Computer Engineering.
ERROR CONTROL FOR RELIABLE DIGITAL DATA TRANSMISSION AND STORAGE SYSTEMS Final Report
Daniel J. Costello, Jr. and Robert H. Deng 30 Sep. 1985 94 p
(Grant NAG2-202)
(NASA-CR-176935; NAS 1.26:176935) Avail: NTIS HC A05/MF A01 CSCL 09B

A problem in designing semiconductor memories is to provide some measure of error control without requiring excessive coding overhead or decoding time. In LSI and VLSI technology, memories are often organized on a multiple bit (or byte) per chip basis. For example, some 256K-bit DRAM's are organized in 32Kx8 bit-bytes. Byte oriented codes such as Reed Solomon (RS) codes can provide efficient low overhead error control for such memories. However, the standard iterative algorithm for decoding RS codes is too slow for these applications. In this paper we present some special decoding techniques for extended single-and-double-error-correcting RS codes which are capable of high speed operation. These techniques are designed to find the error locations and the error values directly from the syndrome without having to use the iterative alorithm to find the error locator polynomial. Two codes are considered: (1) a d sub min = 4 single-byte-error-correcting (SBEC), double-byte-error-detecting (DBED) RS code; and (2) a d sub min = 6 double-byte-error-correcting (DBEC), triple-byte-error-detecting (TBED) RS code. Author

N86-29553# Sandia National Labs., Albuquerque, N. Mex.
DATA ACQUISITION AND ANALYSIS USING THE IBM COMPUTER SYSTEM 9000
G. E. Mueller Oct. 1985 62 p
(Contract DE-AC04-76DP-00789)
(DE86-005799; SAND-85-1448) Avail: NTIS HC A04/MF A01

A data-acquisition, analysis, and graphing program has been

developed on the IBM CS-9000 multitask computer to support the UNM/SNL/GA Thermal-Hydraulic Test Facility. The software has been written in Computer System BASIC which allows accessing and configuring I/O devices. The CS-9000 has been interfaced with an HP 3497A Data Acquisition/Control Unit and an HP 7470A Graphics Plotter through the IEEE-488 Bus. With this configuration the system is capable of scanning 60 channels of analog thermocuple compensated input, 20 channels of analog pressure transducer input, and 16 channels of digital mass flow rate input. The CS-9000 graphics coupled with the HP 7470A provides useful visualization of changes in measured parameters. DOE

N86-29554# Japan Atomic Energy Research Inst., Tokyo.
PALLAS-1D(7): A CODE FOR DIRECT INTEGRATION OF TRANSPORT EQUATION IN ONE-DIMENSIONAL PLANE AND SPHERICAL GEOMETRIES
K. Takeuchi and S. Tanaka Dec. 1984 81 p Prepared in cooperation with Japan Atomic Energy Research Inst., Tokai, Ibaraki
(DE86-701087; JAERI-M-84-214) Avail: NTIS (US Sales Only) HC A05/MF A01

The PALLAS-1D (7) program is the revised version of the PALLAS-PL, SP-Br code which was developed in 1981 on the basis of a method of direct integration of the Boltzmann transport equation to neutron and gamma-ray transport in one-dimensional plane and spherical geometries. The PALLAS-1D (7) code can treat transport of both neutrons and gamma rays, in particular of secondary gamma rays including the bremsstrahlung and annihilation photons or secondary photons from nuclear reactions of neutrons. The document gives a full description of theoretical calculation, input and output data, as well as code implementation information and the input description of several sample problems. DOE

N86-29555# Lawrence Livermore National Lab., Calif.
VECTOR AND PARALLEL COMPUTERS FOR QUANTUM MONTE CARLO COMPUTATIONS
P. J. Reynolds, S. Alexander, D. Logan, and W. A. Lester, Jr. Aug. 1985 28 p Presented at the Conference on Supercomputer Simulations in Chemistry, Montreal, Quebec, 25 Aug. 1985
(Contract DE-AC03-76SF-00098)
(DE86-002955; LBL-20085; CONF-8508156-1) Avail: NTIS HC A03/MF A01

Monte Carlo simulations are inherently computer-bound. Although short computations may provide order-of-magnitude estimates, long CPU times are generally required to achieve the accuracy needed for reliable comparison of Monte Carlo results with experiment or theory. The advent of supercomputers, which have made possible significantly increased computer speeds for those applications which are amenable to vector or parallel processing, thus offers promise for Monte Carlo applications. In fact, Monte Carlo codes are often highly parallel, and offer multiple avenues for both parallelisation and vectorization. We explore the gains to be obtained with supercomputers for the quantum Monte Carlo (QMC) method. The QMC algorithm treated here is used in quantum mechanical molecular calculations, to obtain solutions to the Schroedinger equation. This approach has recently been shown to achieve high accuracy in electronic structure computations. QMC is here demonstrated to fully take advantage of parallel and vector processor systems. Levels of parallelism are discussed, and an overview of parallel computer architectures, as well as present vector supercomputers is given. We also discuss how one adapts QMC to these machines. Performance ratios (versus scalar operation) for a number of supercomputer systems are given.DOE

N86-29556# Oak Ridge National Lab., Tenn.
CONTROL ALGORITHMS FOR AUTONOMOUS ROBOT NAVIGATION
C. C. Jorgensen 20 Sep. 1985 29 p Presented at the International Topical Meeting on Advances in Human Factors in Nuclear Power Systems, Knoxville, Tenn., 21 Apr. 1986
(Contract DE-AC05-84OR-21400)
(DE86-002209; CONF-860415-1) Avail: NTIS HC A03/MF A01

This paper examines control algorithm requirements for autonomous robot navigation outside laboratory environments. Three aspects of navigation are considered: navigation control in explored terrain, environment interactions with robot sensors, and navigation control in unanticipated situations. Major navigation methods are presented and relevance of traditional human learning theory is discussed. A new navigation technique linking graph theory and incidental learning is introduced. DOE

N86-29557# Los Alamos National Lab., N. Mex.
EXPERT ASSISTANTS FOR DESIGN
J. Aldridge, J. Cerutti, W. Draisin, and M. Steuerwalt 1986 12 p Presented at the 1st International Conference on Applications of AI to Engineering Problems, Southhampton, England, 1 Apr. 1986
(Contract W-7405-eng-36)
(DE86-003679; LA-UR-85-3970; CONF-860472-1) Avail: NTIS HC A02/MF A01

Two expert programs currently under development at the Los Alamos National Laboratory, PROCON and the Designer's Apprentice, are briefly described. Both codes define interface to simulations that provide a wide variety of information about the performance of complex devices. DOE

N86-29558# Argonne National Lab., Ill.
LINEAR ALGEBRA ON HIGH-PERFORMANCE COMPUTERS
J. J. Dongarra and D. C. Sorensen Jan. 1986 45 p
(Contract W-31-109-eng-38)
(DE86-007265; ANL-86-2) Avail: NTIS HC A03/MF A01

This paper surveys work recently done at Argonne National Laboratory in an attempt to discover ways to construct numerical software for high-performance computers. The numerical algorithms are taken from several areas of numerical linear algebra. We discuss certain architectural features of advanced-computer architectures that will affect the design of algorithms. The technique of restructuring algorithms in terms of certain modules is reviewed. This technique has proved successful in obtaining a high level of transportability without severe loss of performance on a wide variety of both vector and parallel computers. The module technique is demonstrably effective for dense linear algebra problems. However, in the case of sparse and structured problems it may be difficult to identify general modules that will be as effective. New algorithms have been devised for certain problems in this category. We present examples in three important areas: banded systems, sparse QR factorization, and symmetric eigenvalue problems. DOE

N86-29559# Sandia National Labs., Albuquerque, N. Mex.
GRASP USER MANUAL: A COMPUTER PROGRAM FOR PRESSURE ANALYSIS, VERSION 1.0
W. C. Mills-Curran Feb. 1986 40 p
(Contract DE-AC04-76DP-00789)
(DE86-007406; SAND-85-2423) Avail: NTIS HC A03/MF A01

The GRASP computer code (Graphic Analyzer and Shell Shock Preprocessor) is an interactive tool for analyzing large amounts of pressure data on a conical shell. With GRASP, the user can visualize the complex pressure distributions on an aeroshell at any time step. Pressure data from multiple sources can be compared, and load data for structural analysis may be generated. GRASP is extremely user friendly and is written to use the Sandia, Virtual Device Interface. DOE

N86-29560# Illinois Univ., Urbana. Dept. of Computer Science.
APPLICATIONS OF A SOFTWARE INTERCONNECTION SYSTEM IN MATHEMATICAL PROBLEM SOLVING ENVIRONMENTS
J. M. Purtilo Mar. 1986 19 p
(Contract DE-AC02-76ER-02383)
(DE86-007642; UIUCDCS-R-86-1254; UILU-ENG-86-1709; COO-2383-0117) Avail: NTIS HC A02/MF A01

The project called Polylith at University of Illinois at Urbana studies environment construction by first addressing those problems embedded in the underlying software interconnection technology. A new model of interconnection has been proposed, and a run-time system consistent with that model is implemented.

The result is a software design system that facilitates rapid prototyping and reuse of existing tools. In that our project applies these techniques to instantiating environments for mathematical problem solvers, we view Polylith as an environment design system. In this paper we discuss how Polylith can directly aid both environment builders and users alike. Section 2 of this paper gives an overview of our system, and then considers difficulties that arise in construction of environments where older interconnection technology is employed. Section 3 cites examples of new functionality that can be available in environments built using our type of tool bus. DOE

N86-29561# Lawrence Livermore National Lab., Calif.
CODE DEVELOPMENT WITH THE EAGLES ENGINEERING PROBLEM-SOLVING ENVIRONMENT
B. S. Lawver, D. W. OBrien, and M. E. Poggio Feb. 1986 9 p
(Contract W-7405-eng-48)
(DE86-008107; UCID-20666) Avail: NTIS HC A02/MF A01

EAGLES is a set of computer programs which assist in the development and use of engineering analysis and simulation codes. This paper introduces EAGLES to the developers of engineering codes. EAGLES' capabilities, functions, and tools for code development are explained. DOE

N86-29562*# Societe Nationale Industrielle Aerospatiale, Toulouse (France).
THE UCLA DESIGN DIVERSITY EXPERIMENT (DEDIX) SYSTEM: A DISTRIBUTED TESTBED FOR MULTIPLE-VERSION SOFTWARE
A. Avizienis, P. Gunningberg, J. P. J. Kelly, L. Strigini, P. J. Traverse, K. S. Tso, and U. Voges 1986 11 p Presented at 15th IEEE Ann. Intern. Symp. on Fault Tolerance Computing, Ann Arbor, Mich., 19-21 Jun. 1985 Sponsored by FAA Prepared in cooperation with California Univ., Los Angeles
(Grants NAG1-512; NSF MCS-81-21696)
(NASA-CR-177171; NAS 1.26:177171; SNIAS-861-111-107; ESA-86-97144) Avail: NTIS HC A02/MF A01 CSCL 09B

To establish a long-term research facility for experimental investigations of design diversity as a means of achieving fault-tolerant systems, a distributed testbed for multiple-version software was designed. It is part of a local network, which utilizes the Locus distributed operating system to operate a set of 20 VAX 11/750 computers. It is used in experiments to measure the efficacy of design diversity and to investigate reliability increases under large-scale, controlled experimental conditions. ESA

N86-29563*# Societe Nationale Industrielle Aerospatiale, Toulouse (France).
SOFTWARE FAULT-TOLERANCE BY DESIGN DIVERSITY DEDIX: A TOOL FOR EXPERIMENTS
A. Avizienis, P. Gunningberg, J. P. J. Kelly, R. T. Lyu, L. Strigini, P. J. Traverse, K. S. Tso, and U. Voges 1986 8 p Presented at SAFECOMP 85, Como, Italy, 1-3 Oct. 1985 Sponsored by FAA Prepared in cooperation with California Univ., Los Angeles
(Grants NAG1-512; NSF MCS-81-21696)
(NASA CR-177172; NAS 1.26:177172; SNIAS-861-111-108; ESA-86-97145) Avail: NTIS HC A02/MF A01 CSCL 09B

The use of multiple versions of a computer program, independently designed from a common specification, to reduce the effects of an error is discussed. If these versions are designed by independent programming teams, it is expected that a fault in one version will not have the same behavior as any fault in the other versions. Since the errors in the output of the versions are different and uncorrelated, it is possible to run the versions concurrently, cross-check their results at prespecified points, and mask errors. A DEsign Diversity eXperiments (DEDIX) testbed was implemented to study the influence of common mode errors which can result in a failure of the entire system. The layered design of DEDIX and its decision algorithm are described. ESA

N86-29564# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
THE BLAS ON THE CYBER 205
Margreet Louter-Nool Dec. 1985 27 p Submitted for publication
(CWI-NM-R8524; B8660190; ESA-86-97512) Avail: NTIS HC A03/MF A01

The efficiency of a set of linear algebra subprograms, the so-called BLAS, as implemented on a 1-pipe Cyber 205 is discussed. Operations on nonsequentially stored vector elements, leading to so-called stride problems, are considered. It is shown that splitting the real and imaginary components for the COMPLEX BLAS without an additional stride problem is not the most efficient manner. But, if there is a stride problem, and consequently disjunct vectors of real and of imaginary components are created, it is recommended to take full advantage of this data structure. All execution times of the CDC BLAS subprograms can be improved for all increment values >1, except for the subprograms SCNRM2 and CSSCAL. The performance of SCNRM2 and CSSCAL do not suffer on the inherent troublesome storage of a COMPLEX vector. Like the REAL SASUM and SROT, the execution times of the COMPLEX routines SCASUM and CSROT can be speeded up. In the case of an additional stride problem, the performance with two disjunct vectors delivers such a considerable gain, that even when only one vector has an increment value value greater than one, it is better to split the real and imaginary components of the other sequentially stored vector. In contradiction with the REAL BLAS, all suggestions are independent of the size of the increment value. ESA

N86-29565# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
A SPICE INPUT TO NETWORK DESCRIPTION AND MODELING LANGUAGE (NDML) COMPILER
R. J. J. vanWaes Dec. 1984 62 p
(ESA-86-97531) Avail: NTIS HC A04/MF A01

A piecewise linear simulator for electronic circuits was developed. To be able to accept circuit descriptions prepared for the simulator SPICE, and to compare the performance of the piecewise linear simulator and SPICE, a compiler was constructed. The compiler translates input for SPICE to input written in Network Description and Modeling Language which is the input language of the piecewise linear simulator. ESA

N86-29566# Kernforschungszentrum, Karlsruhe (West Germany).
FINITE ELEMENT DATA INTERFACE STANDARD (FEDIS)
P. Groth, H. M. Hilber, C. Katz, and H. Werner Nov. 1985 92 p In GERMAN; ENGLISH summary
(Contract BMFT-F11.021-RT-TPG/11)
(KfK-PFT-114; ESA-86-96909) Avail: NTIS HC A05/MF A01

A standard interface for the transfer of data between independent programs for the generation, analysis, and postprocessing of finite element models is proposed. The interface program supports and facilitates the integration of program packages which are simultaneously used for one project. The data types and the general structure of the proposed interface are presented. The interface program is documented. The program architecture, data management system, and interpreter are described. Applications are given to illustrate the state of the program development. ESA

N86-29567# National Bureau of Standards, Gaithersburg, Md. Inst. for Computer Sciences and Technology.
INTEGRATED SOFTWARE FOR MICROCOMPUTER SYSTEMS Final Report
L. S. Rosenthal Jan. 1986 41 p
(PB86-167830; NBS-SP-500-135; LC-86-600500) Avail: NTIS HC A03/MF A01; also available SOD HC $1.75 as 003-003-02711-1 CSCL 09B

Integrated software products combine several applications within a single program and permit information to be shared between the applications. The report defines five approaches to integration: the all-in-one, product suite, software integrator, operating environment, and background utility. Each of these approaches is designed to achieve different objectives by emphasizing the power and importance of the features of each approach. Consequently, there is no best approach to software integration. The selection of an approach depends on the application require-

ments, current system configurations, and personal preferences. Selecting an integrated product begins by considering the various approaches to integration and determining which one is most appropriate. Subsequently, the products within the chosen approach are evaluated against a preestablished set of criteria relating to the product design, technical capabilities, and product quality. Careful selection of an integrated product will insure that the benefits to be gained from its use can be achieved. GRA

N86-29285*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DATA SET MANAGEMENT
Mary Reph *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 17 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29286*# Science Applications Research, Lanham, Md.
DEMONSTRATION OF NEW PCSD CAPABILITIES
Michael Gough *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 8 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29300*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE CDF SOFTWARE PACKAGE
C. Edwin Wilson *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 11 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

62 COMPUTER SYSTEMS

Includes computer networks.

N86-29568*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ACCESS CONTROL AND PRIVACY IN LARGE DISTRIBUTED SYSTEMS
Barry M. Leiner and Matt Bishop 7 Mar. 1986 18 p
(Contract NCC2-387)
(NASA-TM-89397; RIACS-TR-86.6; NAS 1.15:89397) Avail: NTIS HC A02/MF A01 CSCL 09B

Large scale distributed systems consists of workstations, mainframe computers, supercomputers and other types of servers, all connected by a computer network. These systems are being used in a variety of applications including the support of collaborative scientific research. In such an environment, issues of access control and privacy arise. Access control is required for several reasons, including the protection of sensitive resources and cost control. Privacy is also required for similar reasons, including the protection of a researcher's proprietary results. A possible architecture for integrating available computer and communications security technologies into a system that meet these requirements is described. This architecture is meant as a starting point for discussion, rather that the final answer. Author

N86-29569*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
WHITE PAPER: A PLAN FOR COOPERATION BETWEEN NASA AND DARPA TO ESTABLISH A CENTER FOR ADVANCED ARCHITECTURES
Peter J. Denning, George B. Adams, III, Robert L. Brown, Pentti Kanerva, Barry M. Leiner, and Michael R. Raugh 25 Apr. 1986 14 p
(Contract NCC2-387)
(NASA-TM-89388; RIACS-TR-86.10; NAS 1.15:89388) Avail: NTIS HC A02/MF A01 CSCL 09B

Large, complex computer systems require many years of development. It is recognized that large scale systems are unlikely to be delivered in useful condition unless users are intimately involved throughout the design process. A mechanism is described that will involve users in the design of advanced computing systems and will accelerate the insertion of new systems into scientific research. This mechanism is embodied in a facility called the Center for Advanced Architectures (CAA). CAA would be a division of RIACS (Research Institute for Advanced Computer Science) and would receive its technical direction from a Scientific Advisory Board established by RIACS. The CAA described here is a possible implementation of a center envisaged in a proposed cooperation between NASA and DARPA. Author

N86-29570# Texas Univ., Austin. Dept. of Computer Sciences.
A COMPUTABILITY THEORY FOR DISTRIBUTED SYSTEMS Final Report
Jayadev Misra 13 Mar. 1986 87 p
(Contract N00014-85-K-0057)
(AD-A166081) Avail: NTIS HC A05/MF A01 CSCL 09/2

The work proposed under this grant was to develop theories which will contribute to the design and analysis of distributed systems. The major emphasis of the proposed research was to study how and why processes in a message passing system need to communicate. Contents: Learning from incomplete information; Understanding a Byzantine algorithm; On the nonexistence of robust commit protocol; How processes learn; A Really abstract concurrent model and its temporal logic; and Systolic algorithms as programs. GRA

N86-29571# Rochester Univ., N. Y. Dept. of Computer Science.
DISTRIBUTED DATA STRUCTURES: A CASE STUDY
Carla S. Ellis Aug. 1985 33 p
(Contract N00014-82-K-0193; Grants NSF MCS-82-03306; NSF DCR-83-20136)
(AD-A166083; TR-150) Avail: NTIS HC A03/MF A01 CSCL 09/2

In spite of the amount of work recently devoted to distributed system, distributed applications are relatively rare. One hypothesis to explain this scarcity of different examples is a lack of experience with algorithm design techniques tailored to an environment in which out-of-date and incomplete information is the rule. Since the design of data structures is an important aspect of traditional algorithm design, it is important to consider the problem of distributing data structures. This paper investigates these issues by developing a distributed version of an extendible hash file which is a dynamic indexing structure that could be useful in a distributed database. Hashing has long been recognized as a fast method for accessing records by key in large relatively static databases. However, when the amount of data is likely to vary significantly, traditional hashing can suffer from performance degradation and may eventually require rehashing all the records into a larger space. GRA

N86-29572# Illinois Univ., Urbana. Dept. of Computer Science.
ENVIRONMENTS FOR PROTOTYPING PARALLEL ALGORITHMS
J. Purtilo, D. A. Reed, and D. C. Grunwald Feb. 1986 24 p
(Contract DE-AC02-76ER-02383)
(DE86-007645; UIUCDCS-R-86-1249; UILU-ENG-86-1707; COO-2383-0118) Avail: NTIS HC A02/MF A01

The current ferment in parallel computer architecture has exacerbated the already large problems in developing and testing parallel algorithms. Although only experimentation will identify effective designs, the variety of computing paradigms has precluded development of the (necessary) general environment for parallel programming. We propose an environment design system where design specification is divorced from implementation. Because the design system, Polylith, provides the communication structure of a parallel computation, the computation's individual tasks can be written in one of several relatively portable sequential languages. The resulting parallel program is architecture independent; only Polylith's underlying communication support need be ported to execute code on a different parallel machine. This approach is

illustrated using examples from both parallel simulation and partial differential equations. DOE

N86-29573# Sandia National Labs., Albuquerque, N. Mex.
THE 9600 BPS ROUTING VIA SYNCHRONIZED PACX 1000 NETWORK
M. M. Miller 25 Mar. 1986 10 p Presented at the Galdalf PACX User Group Meeting, Atlanta, Ga., 25 Mar. 1986
(Contract DE-AC04-76DP-00789)
(DE86-007824; SAND-86-0575C; CONF-860387-1) Avail: NTIS HC A02/MF A01

In order to achieve 9600 bps routing through the Gandalf PACX-based terminal switching network at Sandia National Laboratories, the network was upgraded to PACX 1000 switches synchronized to GLM 528 multiplexers. This presentation describes the network architecture and how the PACX switches and multiplexers have been synchronized to achieve minimum data distortion and improved character transmission rate. DOE

N86-29574# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. d'Informatique.
STUDY, IMPLEMENTATION AND MODELS OF LOW STAGE PROTOCOLS FOR INTEGRATED SERVICE NETWORKS Ph.D. Thesis [ETUDES, REALISATION ET MODELISATION DES COUCHES BASES DE PROTOCOLES POUR LES RESEAUX A INTEGRATION DE SERVICE]
Wu Ai Oct. 1985 133 p In FRENCH
(ENST-85E008; ISSN-0751-1353; ESA-86-97212) Avail: NTIS HC A07/MF A01

The architecture and protocols for integrated service local networks are studied. The design and implementation of a computer program for the data link stage of the experimental Excalibur network are described. A model and the evaluation of the Excalibur network are presented. The choice of a semideterministic access protocol assures a minimum data flow for each station. The Excalibur architecture is efficient for data transmission, telephony, and television applications as well. ESA

N86-29284*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PCDS OVERVIEW
Lloyd Treinish *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 18 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

63 CYBERNETICS

Includes feedback and control theory.

For related information see also *54 Man/System Technology and Life Support.*

N86-29575*# Massachusetts Inst. of Tech., Cambridge. Lab. for Information and Decision Systems.
BEYOND SINGULAR VALUES AND LOOP SHAPES
Gunter Stein Oct. 1985 18 p
(Grant NAS2-297)
(NASA-CR-177018; NAS 1.26:177018; LIDS-P-1504) Avail: NTIS HC A02/MF A01 CSCL 09B

The status of singular value loop-shaping as a design paradigm for multivariable feedback systems is reviewed. It shows that this paradigm is an effective design tool whenever the problem specifications are spacially round. The tool can be arbitrarily conservative, however, when they are not. This happens because singular value conditions for robust performance are not tight (necessary and sufficient) and can severely overstate actual requirements. An alternate paradign is discussed which overcomes these limitations. The alternative includes a more general problem formulation, a new matrix function mu, and tight conditions for both robust stability and robust performance. The state of the art currently permits analysis of feedback systems within this new paradigm. Synthesis remains a subject of research. Author

N86-29576# Carnegie-Mellon Univ., Pittsburgh, Pa. Robotics Inst.
MODELING AND CONTROL OF ASSEMBLY TASKS AND SYSTEMS Interim Report
Bruce H. Krogh and Arthur C. Sanderson Jul. 1985 39 p
(AD-A166445; CMU-RI-TR-86-1) Avail: NTIS HC A03/MF A01 CSCL 05/1

This report reviews ongoing research in modeling and control of assembly systems. A modeling framework is developed for representing assembly tasks as a collection of discrete operations with precedence relations reflecting physical constraints. Devices are mapped into the subtask description leading to an 'operation precedence graph' which is useful for analyzing alternative system configurations and supervisory control structures. Underlying continous processes determine the tolerance requirements for accomplishing the subtasks. Since reducing uncertainty in the system configuration is the fundamental objective in assembly tasks, two alternatives for representing uncertainty are defined and illustrated by examples. These representations of uncertainty are discussed with respect to alternative feedback control strategies for satisfying tolerance constaints. The concluding section identifies directions for future research. GRA

N86-29577# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
OPTIMAL CONTROL AND SIMULATION: EXTENSION OF THE INTERACTIVE PROGRAM PACKAGE SATER
Guoji Sun (Xian Jiaotong Univ., China) May 1984 44 p Sponsored by Netherlands government
(ER-84/01; ESA-86-97521) Avail: NTIS HC A03/MF A01

Application programs, such as continuous simulation, s-z conversion, and optimal control, were written to extend the interactive program package SATER for identification of linear single input single output systems. For solving the matrix Riccati differential equation of optimal control with a quadratic performance index, and Kalman filter of the continuous systems, three methods and their comparison of convergence speed are presented. In the continuous simulation, which can be applied to calculate the responses of the open-loop system and the closed-loop system with optimal feedback, the Euler method, fourth Runge-Kutta method and Runge-Kutta-Merson variable-step method are provided. The bilinear z-transformation is used for s-z conversion. The algorithm for calculating the feedback matrices of optimal control and state observer of discrete models is described. ESA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N86-29578*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
APPROXIMATING LINEARIZATIONS FOR NONLINEAR SYSTEMS Semiannual Progress Report
L. R. Hunt (Texas Univ., Dallas.), R. Su (Colorado Univ., Boulder.), and G. Meyer 1986 23 p
(Grants NAG2-189; NAG2-366; NAG2-203; Contract N00014-76-C1136)
(NASA-TM-88772; NAS 1.15:88772) Avail: NTIS HC A02/MF A01 CSCL 12A

The following problem is examined: given a nonlinear control system dot-x(t) = f(x(t)) + the sum to m terms(i=1) u sub i (t)g sub i (x(t)) on R(n) and a point x(0) in R(n), approximate the system near x(0) by a linear system. One approach is to use the usual Taylor series linearization. However, the controllability properties of both the nonlinear and linear systems depend on certain Lie brackets of the vector field under consideration. This suggests that a linear approximation based on Lie bracket matching should be constructed at x(0). In general, the linearizations based on the Taylor method and the Lie bracket approach are different. However, under certain mild assumptions, it is shown that there is

a coordinate system for R(n) near x(0) in which these two types of linearizations agree. The importance of this agreement is indicated by examining the time responses of the nonlinear system and its linear approximation and comparing the lower order kernels in Volterra expansions of each. M.G.

N86-29579*# Syracuse Univ., N. Y. Dept. of Mechanical and Aerospace Engineering.
LINEAR AND NONLINEAR DYNAMIC ANALYSIS OF REDUNDANT LOAD PATH BEARINGLESS ROTOR SYSTEMS Status Report
V. R. Murthy Dec. 1985 94 p
(Grant NAG2-306)
(NASA-CR-177098; NAS 1.26:177098) Avail: NTIS HC A05/MF A01 CSCL 12A

The bearingless rotorcraft offers reduced weight, less complexity and superior flying qualities. Almost all the current industrial structural dynamic programs of conventional rotors which consist of single load path rotor blades employ the transfer matrix method to determine natural vibration characteristics because this method is ideally suited for one dimensional chain like structures. This method is extended to multiple load path rotor blades without resorting to an equivalent single load path approximation. Unlike the conventional blades, it isk necessary to introduce the axial-degree-of-freedom into the solution process to account for the differential axial displacements in the different load paths. With the present extension, the current rotor dynamic programs can be modified with relative ease to account for the multiple load paths without resorting to the equivalent single load path modeling. The results obtained by the transfer matrix method are validated by comparing with the finite element solutions. A differential stiffness matrix due to blade rotation is derived to facilitate the finite element solutions. Author

N86-29580*# Massachusetts Inst. of Tech., Cambridge.
MULTIVARIABLE CONTROL SYSTEMS WITH SATURATING ACTUATORS ANTIRESET WINDUP STRATEGIES
Petros Kapasouris and Michael Athans May 1985 6 p Sponsored in part by General Electric Co.
(Grants NAG2-297; NGL-22-009-124)
(NASA-CR-177100; NAS 1.26:177100; LIDS-P-1461) Avail: NTIS HC A02/MF A01 CSCL 12A

Preliminary, promising, results for introducing antireset windup (ARW) properties in multivariable feedback control systems with multiple saturating actuator nonlinearities and integrating actions are presented. The ARW method introduces simple nonlinear feedback around the integrators. The multiloop circle criterion is used to derive sufficient conditions for closed-loop stability that employ frequency-domain singular value tests. The improvement in transient response due to the ARW feedback is demonstrated using a 2-input 2-outpurt control system based upon F-404 jet engine dynamics. Author

N86-29581*# Honeywell Systems and Research Center, Minneapolis, Minn.
BEYOND SINGULAR VALUES AND LOOP SHAPES
Gunter Stein 30 Aug. 1985 19 p
(Grant NAG2-297)
(NASA-CR-177087; NAS 1.26:177087; LIDS-P-1504) Avail: NTIS HC A02/MF A01 CSCL 12A

The status of singular value loop-shaping as a design paradigm for multivariable feedback systems is reviewed. It is demonstrated that this paradigm is an effective design tool whenever the problem specifications are spacially round. The tool can be arbitrarily conservative, however, when they are not. This happens because singular value conditions for robust performance are not tight (necessary and sufficient) and can severely overstate actual requirements. An alternate paradigm is discussed which overcomes these limitations. The alternative includes a more general problem formulation, a new matrix function mu, and tight conditions for both robust stability and robust performance. The state of the art currently permits analysis of feedback systems within this new paradigm. Synthesis remains a subject of research. Author

N86-29582# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
A NONLINEAR BOUNDARY VALUE PROBLEM AND APPLICATIONS TO A DIFFUSION PROBLEM WITH RADIAL SYMMETRIES
Sonia Maria Gomes May 1986 21 p Sponsored by Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil) Presented for publication
(INPE-3909-PRE/949) Avail: NTIS HC A02/MF A01

Diffusion controlled growth of planar, cylindrical, or spherical particles is considered, where the composition satisfies a generalized diffusion equation. Similarity solutions for this problem are analyzed via an equivalent one-dimensional nonlinear boundary value problem. For such problems it is shown existence, uniqueness, and solutions comparison theorems. Then, in the diffusion context again, several results are stated and completed, specially those concerning a limit flux averaged at infinity. Author

N86-29583# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
SOME ASPECTS TO BE CONSIDERED IN THE ATTEMPT TO FIND MORE EFFICIENT METHODS FOR SOLVING OPTIMIZATION PROBLEM BY ENUMERATION
Nei Yoshihiro Soma and Horacio Hideki Yanasse May 1986 18 p Presented at the 3rd Latin Ibero American Congress on Operations Research, Santiago, Chile, 18-22 Aug., 1986
(INPE-3898-PRE/940) Avail: NTIS HC A02/MF A01

In an enumeration scheme to solve the unidimensional knapsack problem, two characteristics called attention: the reduction of an N-dimensional problem to one in the plane; and visiting states and stages in a different sequence than the traditional dynamic programming improved memory and computational requirements. The implementation resulted in a more efficient algorith compared with others using dynamic programming. The focus of this work is making comparisons with the traditional methods. Such observations are potentially useful to other researches in developing new and more efficient methods for solving some optimization problems. Author

N86-29584# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DESIGN OF A STOCHASTIC LINEAR DISCRETE REGULATOR BASED ON AN OPTIMAL STATE ESTIMATION APPROACH
A. Rios-Neto May 1986 12 p Sponsored by Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil) Submitted for publication
(INPE-3902-PRE/943) Avail: NTIS HC A02/MF A01

The problem of regulator design for stochastic linear discrete-time systems by otpimizing a quadratic index of performance is considered. Loose separability is assumed and one-step-ahead minimization of control magnitude and of controlled state deviation from zero is imposed to determine the control law. To determine the weighting matrices in the index of performance, a state estimation based scheme of analysis is proposed. With this approach these matrices are taken as covariance matrices, through the use, one step ahead, of the information about allowed control magnitude and possible and desirable state deviation from zero. Convergence of the proposed regulator is analyzed also using a state estimation equivalent problem approach. Complete observability and complete controllability are shown to guarantee the existence of a sequence of stabilizing control values, which can be estimated by the adopted optumization design approach. The structure of the resulting control law depends only on past and present knowledge of system dynamics, making the proposed solution suitable for applications where adaptive control is necessary. Author

N86-29585# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
BATCH AND SEQUENTIAL DATA SMOOTHING AND COMPRESSION BY CURVE FITTING USING AND ADAPTIVE STATE ESTIMATION TECHNIQUE
Valcir Orlando, Atair Rios Neto, and Helio Koiti Kuga May 1986

17 p To be presented at the 10th World Congress International Fedeation of Automatic Control, Munich, West Germany, 26-31 Jul. 1987 Sponsored by Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil) To be submitted for publication
(INPE-3885-PRE/935) Avail: NTIS HC A02/MF A01

The problem of data smoothing and compression by curve fitting is formulated to allow the application of Kalman filtering and a state noise estimation technique to its solution. This leads to a procedure that can be used to process the data either in batch or sequentially. The capability of sequential processing opens the possiblity of curve fiting in real time. Tests done with digitally simulated satellite tracking data indicate that the procedure has a satisfactory performance, being a potentially promising tool for data preprocessing. Author

N86-29586# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
STATE ESTIMATION OF MULTIVARIABLE SYSTEMS USING THE DUALITY CONCEPT
Agenor DeToledoFleury and Atair Rios Neto Apr. 1986 26 p Presented at the 10th Diname-Symposium on Dynamical Systems in Mechanics Sponsored by Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil) Submitted for publication
(INPE-3857-PRE/921) Avail: NTIS HC A03/MF A01

A state estimator for dynamic systems based upon the duality concept between state estimation and optimal control problems was developed. This leads to an estimator algorithm silmilar to the Extended Kalman Filter for use in real time nonlinear systems, which can recursively be approximated by linear systems. The duality concept is used to transform the original estimation problem into an equivalent one of virtual control. This control problem is then used to generate an adaptive, locally convergent algorithm where, instead of full state estimation, one has to estimate just a control vector with smaller dimension than the state vector. The control formulation also allows the development of convergence acceleration criteria. Three convergence criteria, as well as adaptive noise methods to compensate for model errors, are then developed and used with the proposed estimator in the test problem created to validate the estimator. The algorithm is implemented in a digital computer to estimate the orbit of a low Earth orbit satellite under simulated conditions. Numerical results include test cases considering different initial values for the estimator and different standard deviations for the observations provided by three Earth stations, allowing a preliminary evaluation of the estimator characteristics. Author

N86-29587*# Texas Technological Univ., Lubbock. Dept. of Electrical Engineering and Computer Science.
A CANONICAL FORM FOR NONLINEAR SYSTEMS
Renjeng Su and L. R. Hunt 1985 19 p
(Grants NAG2-203; NAG2-189; Contract N00014-76-C-1136)
(NASA-CR-176941; NAS 1.26:176941) Avail: NTIS HC A02/MF A01 CSCL 12A

The conceptions of transformation and canonical form have been much used to analyze the structure of linear systems. A coordinate system and a corresponding canonical form are developed for general nonlinear control systems. Their usefulness is demonstrated by showing that every feedback linearizable system becomes a system with only feedback paths in the canonical form. Author

N86-29588# Indian Inst. of Geomagnetism, Bombay.
[RESEARCH AND DEVELOPMENT ACTIVITIES OF THE INDIAN INSTITUTE OF GEOMAGNETISM]
Nanabhai Moos Marg 1983 68 p
Avail: NTIS HC A04/MF A01

The progress in research and on the developmental activities of the Institute during the year 1982 to 1983 is presented. Research activities of the Institute during the year covered some aspects of the geomagnetic variations in the Indian region on quiet and disturbed days, electrojet field, electromagnetic induction, aeronomy, radio scintillations, magnetosphere and solar wind, magnetic pulsations and solar-terrestrial relationships. Significant result of these investigations are given. A list of papers published or under publication during the year is also given. E.R.

N86-29589# Yale Univ., New Haven, Conn. Dept. of Computer Science.
A COMPARISON OF DOMAIN DECOMPOSITION TECHNIQUES FOR ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS AND THEIR PARALLEL IMPLEMENTATION
David E. Keyes and William D. Gropp Dec. 1985 54 p
(Contract N00014-82-K-0184; Grants NSF MCS-81-06181; AF-AFOSR-0360-84)
(AD-A165996; YALEU/DCS/RR-448) Avail: NTIS HC A04/MF A01 CSCL 12/1

Several preconditioned conjugate gradient (PCG)-based domain decomposition techniques for self-adjoint elliptic partial differential equations in two dimensions are compared against each other and against conventional PCG iterative techniques in serial and parallel contexts. The authors consider preconditioners that make use of fast Poisson solvers on the subdomain interiors. Several preconditioners for the interfacial equations are tested on a set of model problems involving two or four subdomains, which are prototype of the stripwise and boxwise decompositions of a two-dimensional region. Selected methods have been implemented on the Intel Hypercube by assigning one processor to each subdomain, making use of up to 64 processors. The choice of a 'best' method for a given problem depends in general upon: (a) the domain geometry, (b) the variability of the operator, and (c) machine characteristics such as the number of processors available and their interconnection scheme, the memory available per processor, and communication and computation rates. Emphasized is the importance of the third category, which has not been as extensively explored as the first two in the domain decomposition literature to date. third category, which has not been as extensively explored as the first two in the domain decomposition literature to date. Author (GRA)

N86-29590# Warwick Univ. Coventry (England). Mathematics Inst.
FLUX AND DIFFERENCES IN ACTION FOR CONTINUOUS TIME HAMILTONIAN SYSTEMS
R. S. MacKay and J. D. Meiss Dec. 1985 12 p
(Contract DE-FG05-80ET-53088)
(DE86-005402; DOE/ET-53088/221; IFSR-221) Avail: NTIS HC A02/MF A01

For a time periodic Hamiltonian H(p,q,t) of period T, the area crossing a collection of curves at time O spanning two homotopic orbits of common period nT, in a time T, is shown to be the difference between the actions, contour integral pdq-Hdt, of the orbits. Similarly in an autonomous Hamiltonian system of two degrees of freedom the flux of energy surface volume per unit time through a surface spanning two homotopic orbits of the same energy is given by the difference between the actions, contour integral p-dq, of the orbits. Analogous results hold for pairs of orbits which converge together in both directions of time. DOE

N86-29591# New York Univ., New York. Mathematics and Computing Lab.
NUMERICAL ANALYSIS AND THE SCIENTIFIC METHOD
J. Glimm and D. H. Sharp Jan. 1986 29 p
(Contracts DE-AC02-76ER03077; W-7405-eng-36)
(DE86-005404; DOE/ER-03077/270) Avail: NTIS HC A03/MF A01

The computer has given rise to a new mode of scientific practice, and today computational science stands beside theory and experiment as a fundamental methodology. The impact of the computer revolution on science can be projected from current trends. The demands to be made on computing methodologies will be reviewed. One of the demands is an ongoing need for excellence in computational methodologies. Generic difficulties encountered in meeting these challenges will be discussed. Recent work of the authors and others will be reviewed in this context. DOE

N86-29592# Illinois Univ., Urbana. Dept. of Computer Science.
PERFORMANCE OF RUNGE-KUTTA CODES WHEN STABILITY RESTRICTS THE STEPSIZE
G. Hall Dec. 1985 18 p
(Contract DE-AC02-76ER-02383)
(DE86-005804; UIUCDCS-R-85-1238; UILU-ENG-85-1746; COO-2383-0114) Avail: NTIS HC A02/MF A01

A theory is given which accounts for the observed behavior of Runge-Kutta codes when the stepsize is restricted by stability. The theory deals with the general case when the dominant eigenvalues of the Jacobian may be a complex conjugate pair. A simple condition on a method is obtained which characterizes its performance in this type of situation and some example calculations are given to illustrate the consequences of the theory. DOE

N86-29593# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
ABOUT A METHOD OF SOLUTION OF THE INVERSE SCATTERING PROBLEM
R. S. Egikyan and E. P. Zhidkov 1985 9 p In RUSSIAN
(DE86-701306; JINR-5-85-366) Avail: NTIS (US Sales Only) HC A02/MF A01

The problem of restoring potential in a Schroedinger equation based on scattering data is considered. In the case of zero orbital momentum, explicit formulae representing potential and wave function through scattering data are proved. The procedure, reducing the general case already considered, is described. DOE

N86-29594# Universidade Federal de Paraiba (Brazil). Dept. de Fisica.
S-EQUIVALENT LAGRANGIANS IN GENERALIZED MECHANICS
L. J. Negri and E. G. daSilva 1985 40 p
(DE86-701307; UFPB-DF-02/85) Avail: NTIS (US Sales Only) HC A03/MF A01

The problem of s-equivalent Lagrangians is considered in the realm of generalized mechanics. Some results corresponding to the ordinary (non-generalized) mechanics are extended to the generalized case. A theorem for the reduction of the higher order Lagrangian description to the usual order is found to be useful for the analysis of generalized mechanical systems and leads to a new class of equivalence between Lagrangian functions. Some new perspectives are pointed out. DOE

N86-29595# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
SYMBOLIC INTEGRATION OF OVERDETERMINED SYSTEMS OF PARTIAL DIFFERENTIAL EQUATIONS (APPLICATION TO THE COMPUTATION OF INFINITESIMAL SYMMETRIES OF NONLINEAR DIFFUSION EQUATIONS)
Paul H. M. Kersten and Peter K. H. Gragert Jul. 1984 123 p
(Memo-430; ESA-86-97360) Avail: NTIS HC A06/MF A01

LISP software was developed for the integration of overdetermined systems of partial differential equations. Application to the computation of the complete Lie algebras of infinitesimal symmetries of nonlinear diffusion equations is illustrated. ESA

N86-29596# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
CRITICAL SETS IN PARAMETRIC OPTIMIZATION
H. Th. Jongen, P. Jonker, and F. Twilt Jul. 1984 26 p
(Memo-433; ESA-86-97361) Avail: NTIS HC A03/MF A01

Finite dimensional optimization problems depending on one parameter are considered. The constraints are of equality and inequality type. Under generic regularity conditions, the local structure of the set of (generalized) critical points is classified. The change of linear and quadratic indices is studied. The subset of critical points of Kuhn-Tucker type is discussed. ESA

N86-29597# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
EXISTENCE OF SPANNING AND DOMINATING TRAILS AND CIRCUITS
H. J. Veldman Jun. 1984 16 p
(Memo-440; ESA-86-97363) Avail: NTIS HC A02/MF A01

For T, a trail of a graph G, T is a spanning trail (S-trail) if T contains all vertices of G; T is a dominating trail (D-trail) if every edge of G is incident with at least one vertex of T. A circuit is a nontrivial closed trail. Sufficient conditions involving lower bounds on the degree-sum of vertices or edges are derived for graphs to have an S-trail, S-circuit, D-trail, or D-circuit. A result of Brualdi and Shanny (1981) on Hamiltonian line graphs and one by Lesniak-Foster and Williamson (1977) on spanning and dominating circuits are improved. ESA

N86-29598# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
PACKINGS OF DIGRAPHS
A. Benhocine, H. J. Veldman, and A. P. Wojda May 1984 13 p
(Memo-454; ESA-86-97366) Avail: NTIS HC A02/MF A01

For D and D', digraphs of order n, a packing of D and D' exists if there are arc-disjoint copies of D and D' with the same vertex set. Using a probabilistic argument, it is shown that a packing of D and D' exists if the product of the sizes of D and D' is $< n(n-1)$. As a consequence, a packing of D and D' exists if the sum of the sizes is at most 2n-2. A constructive proof of the latter result is presented, and the pairs D, D', for which the sum of the sizes equals 2n-1 while there is no packing of D and D',are characterized. ESA

N86-29599# Technische Hogeschool, Eindhoven (Netherlands).
SPECTRUM SHAPING WITH MARKOV CHAINS M.S. Thesis
P. H. N. deWith 1986 69 p Sponsored by Philips Research Laboratories, Eindhoven, Netherlands and Technische Hogeschool, Eindhoven, Netherlands
(NAT-LAB-5926; ESA-86-97392) Avail: NTIS HC A04/MF A01

Performance criteria for dc-free codes are considered. Maximum entropies of binary sequences subject to a particular spectral constraint are presented. It is shown that codes with nearly optimum rate can have considerable differences in dc content. In order to improve the code spectrum, sequences with a bound on the running digital sum (RDS) and on the sum of the RDS are introduced. It is shown that, besides a dc-free power spectrum, these sequences have a zero second derivative at zero frequency, resulting in a substantial decrease of dc content. ESA

N86-29600# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
STABILIZATION OF EXPLICIT METHODS FOR HYPERBOLIC INITIAL-VALUE PROBLEMS
F. W. Wubs Sep. 1985 15 p Submitted for publication Sponsored by Netherlands Foundation for Technical Research
(CWI-NM-R8521; B8660187; ESA-86-97509) Avail: NTIS HC A02/MF A01

A technique by which it is possible to stabilize explicit methods for quasi-linear hyperbolic equations is proposed. The stabilization turns out to be so effective that explicit methods become a good alternative to unconditionally stable implicit methods. ESA

N86-29601# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
THE NUMERICAL SOLUTION OF NONLINEAR VOLTERRA INTEGRAL EQUATIONS OF THE SECOND KIND BY COLLOCATION AND ITERATED COLLOCATION METHODS
J. G. Blom and H. Brunner (Fribourg Univ. (Switzerland).) Oct. 1985 31 p Submitted for publication
(CWI-NM-R8522; B8660186; ESA-86-97510) Avail: NTIS HC A03/MF A01

A variable-stepsize one-step collocation method for solving general nonlinear second kind Volterra integral equations is presented. The iterated collocation method corresponding to polynomial spline collocation is extended to nonlinear Volterra integral equations of the second kind. The resulting superconvergence properties of the collocation approximation or the iterated collocation approximation are used to obtain (local and global) error estimates which in turn form the basis of a variable stepsize

code. The performance of this code is illustrated by test problems. ESA

N86-29602# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
CONVERGENCE AND ORDER REDUCTION OF RUNGE-KUTTA SCHEMES APPLIED TO EVOLUTIONARY PROBLEMS IN PARTIAL DIFFERENTIAL EQUATIONS
J. M. Sanz-Serna, J. G. Verwer, and W. H. Hundsdorfer Dec. 1985 15 p Submitted for publication
(CWI-NM-R8525; B8660184; ESA-86-97513) Avail: NTIS HC A02/MF A01

Convergence of fully discrete explicit Runge-Kutta approximations is discussed. It is proved that under certain conditions, the order in time of the fully discrete scheme equals the conventional order of the Runge-Kutta formula being used. However, these conditions, which are necessary for the result to hold, are not natural. As a result, in many problems the order in time is strictly smaller than the conventional one, a phenomenon called order reduction. Although results are valid for parabolic and hyperbolic problems, the examples are taken from the hyperbolic field, as there explicit discretizations are most appealing. ESA

N86-29603# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Pure Mathematics.
UNIQUENESS AND NONEXISTANCE OF SOME GRAPHS RELATED TO M 22
A. E. Brouwer Jun. 1985 11 p Submitted for publication
(CWI-PM-R8503; B8660194; ESA-86-97514) Avail: NTIS HC A02/MF A01

The unique distance regular graph with intersection array (7, 6, 4, 4; 1, 1, 1, 6) is discussed. It has 330 vertices, and its automorphism group M sub 22.2 acts distance transitively. It does not have an antipodal 2-cover, but it has a unique antipodal 3-cover, and this latter graph has automorphism group 3.M sub 22.2 acting distance transitively. Uniqueness of the strongly regular graph with parameters (v, k, lambda, mu) = (231, 30, 9, 3) under the assumption that it is a gamma space with lines of size 3 is shown. ESA

N86-29604# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Pure Mathematics.
A GROUP THEORETIC INTERPRETATION OF WILSON POLYNOMIALS
T. H. Koornwinder Jun. 1985 23 p Presented at International Conference on Complex Analysis and Applications, Varna, Bulgaria, 5-11 May 1985 Submitted for publication
(CWI-PM-R8504; B8660193; ESA-86-97515) Avail: NTIS HC A02/MF A01

A group theoretic interpretation of Racah polynomials in connection with O(p)xO(r)-invariant spherical harmonics on S sup p+q+r-1, and by analytic continuation, a group theoretic interpretation of Wilson polynomials in connection with O(p)xO(q)xO(r)-invariant harmonics on the hyperboloid O(p+q,r)/O(p+q,r-1) are presented. Full proofs are not given. ESA

N86-29605# Technische Hogeschool, Eindhoven (Netherlands). Dept. of Electrical Engineering.
ON THE CHARACTERIZATION AND PARAMETER ESTIMATION OF MULTIPLE INPUT MULTIPLE OUTPUT (MIMO) SYSTEMS
Pieter Eykhoff Jul. 1984 23 p
(ER-84/03; ESA-86-97523) Avail: NTIS HC A02/MF A01

Model representations and estimation methods for multiple input multiple output (MIMO) systems are summarized. When extending the identification/estimation procedures from single to MIMO-processes, problems grow considerably. For model selection this is particularly due to the number of parameters needed for a model structure that leaves open all feasible (but probably nonexistent) interconnections, interactions, and noise-influences. This implies the desire to include as much a priori knowledge as possible in the selection of the model structure. For parameter estimation, it is desirable to choose the model as being linear-in-the-parameters, in order to attain simple (recursive) estimation algorithms. Unfortunately, this is not compatible with the requirements with respect to the restriction of the number of parameters. For example, a Markov parameter model has the linearity property, but it has a large (infinite) number of parameters. ESA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

No abstracts in this category.

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N86-29606*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
FAIRNESS OF CHANNEL ACCESS FOR NON-TIME-CRITICAL TRAFFIC USING THE FDDI TOKEN RING PROTOCOL
Marjory J. Johnson Mar. 1986 14 p
(Contracts NAS2-11530; NCC2-387)
(NASA-TM-89389; RIACS-TR-86.9; NAS 1.15:89389) Avail: NTIS HC A02/MF A01 CSCL 12B

The Fiber Distributed Data Interface (FDDI) is an ANSI draft proposed standard for a 100 megabit per second fiber optic token ring. FDDI supports two types of traffic, synchronous and asynchronous. Synchronous traffic is time critical traffic; stations are assigned guaranteed bandwidth to support their synchronous needs. Asynchronous traffic is lower priority and is sent only if time permits. It is proved analytically that the FDDI access protocol provides all stations on the ring with equal access to the channel to transmit asynchronous frames, regardless of the relative sizes of synchronous bandwidth allocations for individual stations. Analytic results are supported with data from simulation runs.
Author

N86-29607# Yale Univ., New Haven, Conn. Dept. of Computer Science.
A PROJECTION METHOD FOR PARTIAL POLE ASSIGNMENT IN LINEAR STATE FEEDBACK
Youcef Saad Jan. 1986 17 p
(Contracts N00014-82-K-0184; DAAG29-83-C-0177; DE-AC02-81ER-0996)
(AD-A165997; YALEU/DCS/RR-449) Avail: NTIS HC A02/MF A01 CSCL 12/2

A projection method is proposed for the partial pole placement in continuous time linear control systems. The procedure is of interest in the common situation where the system is very large and only a few of its poles must be assigned. It is based on computing an orthonormal basis of the left invariant subspace associated with the eigenvalues to be assigned and then solving a small inverse eigenvalue problem resulting from projecting the initial problem into that subspace. Also presented is an equivalent version of this method, which can be regarded as a variant of the Wielandt deflation techniques used in eigenvalue methods.
Author (GRA)

N86-29608# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction des Etudes de Synthese.
APPLICATION OF THE SADDLE POINT LOCATION METHOD USED FOR DIFFERENTIAL GAMES TO THREE-DIMENSIONAL PURSUIT-EVASION Final Report [APPLICATION DE LA METHODE D'ENCADREMENT DU POINT-SELLE D'UN JEU DIFFERENTIAL A UN PROBLEME TRIDIMENSIONNEL DE POURSUITE-EVASION]
Nguyen Van Nhan 12 Aug. 1985 61 p In FRENCH

(ONERA-RT-4/3534-SN; ESA-86-97200) Avail: NTIS HC A04/MF A01

The location of the saddle point is carried out by closed loop strategy approximations. The three dimensional interception of a maneuvering aircraft is simulated in a differential pursuit-evasion game using dynamic models with realistic constraints. The saddle point limits are determined by the Marchal method. The evaluation of the degree of optimization achieved and the ways to improve that optimization are discussed. It is shown that the given method permits avoiding the difficult identification of the saddle point, giving a pair of strategies where the degree of optimization can be estimated. ESA

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N86-29609*# Lehigh Univ., Bethlehem, Pa.
ON THE SOLUTION OF INTEGRAL EQUATIONS WITH A GENERALIZED CAUCHY KERNAL
A. C. Kaya and F. Erdogan Hampton, Va. NASA Jun. 1986 23 p
(Grants NGR39-007-011; NSF MEA-84-14477)
(NASA-CR-178139; NAS 1.26:178139) Avail: NTIS HC A02/MF A01 CSCL 12A

A certain class of singular integral equations that may arise from the mixed boundary value problems in nonhonogeneous materials is considered. The distinguishing feature of these equations is that in addition to the Cauchy singularity, the kernels contain terms that are singular only at the end points. In the form of the singular integral equations adopted, the density function is a potential or a displacement and consequently the kernal has strong singularities of the form (t-x)(-2), x(n-2) (t+x)(n), (n is = or > 2, 0 < x, t . b). The complex function theory is used to determine the fundamental function of the problem for the general case and a simple numerical technique is described to solve the integral equation. Two examples from the theory of elasticity are then considered to show the application of the technique. Author

N86-29610*# Lehigh Univ., Bethlehem, Pa.
ON THE SOLUTION OF INTEGRAL EQUATIONS WITH STRONGLY SINGULAR KERNELS
A. C. Kaya and F. Erdogan Jun. 1986 26 p
(Grant NGR39-007-011)
(NASA-CR-178138; NAS 1.26:178138) Avail: NTIS HC A03/MF A01 CSCL 12A

Some useful formulas are developed to evaluate integrals having a singularity of the form (t-x) sup-m ,m greater than or equal 1. Interpreting the integrals with strong singularities in Hadamard sense, the results are used to obtain approximate solutions of singular integral equations. A mixed boundary value problem from the theory of elasticity is considered as an example. Particularly for integral equations where the kernel contains, in addition to the dominant term (t-x) sup -m , terms which become unbounded at the end points, the present technique appears to be extremely effective to obtain rapidly converging numerical results. Author

N86-29611# Georgia Inst. of Tech., Atlanta. Production and Distribution Research Center.
NECESSARY AND SUFFICIENT CONDITIONS FOR THE EXISTENCE OF COMPLEMENTARY SOLUTIONS AND CHARACTERIZATIONS OF THE MATRIX CLASSES Q AND QO
Faiz A. Al-Khayyal Nov. 1985 17 p
(Contract N00014-83-K-0147)
(AD-A165936; PDRC-85-05) Avail: NTIS HC A02/MF A01 CSCL 12/1

The linear complementarity problem has a solution if and only if there exists a right-hand-side vector of an associated dual linear program such that at least one LP solution falls inside a specific open set. This condition is used to given different characterizations of the matrix classes Q and Q sub O. Moreover, they are used to derive verifiable sufficient conditions for a subclass of Q. GRA

N86-29612# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Numerical Mathematics.
REDUCTION OF DISPERSION IN HYPERBOLIC DIFFERENCE SCHEMES BY ADAPTING THE SPACE DISCRETIZATION
P. J. vanderHouwen and B. P. Sommeijer Sep. 1985 15 p Submitted for publication
(CWI-NM-R8519; B8660189; ESA-86-97507) Avail: NTIS HC A02/MF A01

A fourth-order accurate difference scheme for systems of hyperbolic equations is presented. The dispersion in this scheme can be reduced if it is known in advance in which region the frequencies of the dominant Fourier components are located. All method parameters are explicitly expressed in terms of the bounds on the dominating frequencies. The performance of the method is illustrated by application to shallow water equations. ESA

N86-29613# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Pure Mathematics.
THREE LECTURES ON FORMAL GROUPS
Michiel Hazewinkel Jul. 1985 23 p Presented at Canadian Mathematical Society Summer School in Lie Algebra and Related Topics, Windsor, Canada, Jul. 1984
(CWI-PM-R8505; B8660192; ESA-86-97516) Avail: NTIS HC A02/MF A01

Bialgebras; Lie algebra of a formal group; commutativity theorem; logarithms; universal formal groups; a universal p-typical formal group and a formal group universal over Z(p)-algebras; construction of a universal formal group; application to algebraic topology; Atkin-Swinnerton Dyer congruences for elliptic curves; Witt vectors; curves (Frobenius and Verschiebung); Cart(A); Cartier-Dieudonne classification theory; p-typification; universality of the formal group of the Witt vectors; U(W); and noncommutative formal group theory are discussed. ESA

N86-29614# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Pure Mathematics.
A GROUP THEORETIC INTERPRETATION OF THE LAST PART OF DE BRANGES' PROOF OF THE BIEBERBACH CONJECTURE
T. H. Koornwinder Aug. 1985 12 p Submitted for publication
(CWI-PM-R8506; B8660183; ESA-86-97517) Avail: NTIS HC A02/MF A01

A more conceptual and less computational proof for the last part of de Branges' (1985) proof of the Bieberbach conjecture, i.e., where the special functions enter and the Askey-Gasper inequality is applied is given. General solutions of de Branges' system of differential equations are brought in 1-1 correspondence with Fourier-sine series and with spherical function expansions on the sphere S(3). Restriction of spherical functions of S(5) to S(3) and positive definiteness complete the proof. ESA

N86-29615# Center for Mathematics and Computer Science, Amsterdam (Netherlands). Dept. of Pure Mathematics.
PARAMETERIZATION PROBLEMS FOR SPACES OF LINEAR INPUT-OUTPUT SYSTEMS
Michiel Hazewinkel Sep. 1985 11 p Submitted for publication
(CWI-PM-R8507; B8660191; ESA-86-97518) Avail: NTIS HC A02/MF A01

The problem of finding good parameterizations of sets of possible models, mainly finite dimensional dynamic input-output models is discussed. The general problem is addressed in the case where it is impossible to find one global parameterization. ESA

70 PHYSICS (GENERAL)

For geophysics see *46 Geophysics*. For astrophysics see *90 Astrophysics*. For solar physics see *92 Solar physics*.

N86-29616# Sandia National Labs., Albuquerque, N. Mex.
SANDIA TECHNOLOGY. VOLUME 9, NO. 4

P. L. Mead, ed. Dec. 1985 35 p
(Contract DE-AC04-76DP-00789)
(DE86-003430; SAND-85-0799) Avail: NTIS HC A03/MF A01

This issue includes articles on ion-beam focusing in the Particle Beam Fusion Accelerator; embedded atom theory of metals; new experiments on convective heat loss; and an experiment establishing that molten nitrate salt is an efficient working fluid for generating electric power in a solar-thermal central-receiver system. DOE

N86-29617# California Univ., Berkeley. Lawrence Berkeley Lab.
REC AND NdFe MAGNETIC MOMENT IRREVERSIBILITY FROM TEMPERATURE CYCLING
E. Hoyer, J. W. G. Chin, and D. Shuman Oct. 1985 9 p Presented at the International Conference on Insertion Devices, Stanford, Calif., 28 Oct. 1985
(Contract DE-AC03-76SF-00098)
(DE86-007503; LBL-20386; CONF-8510186-10) Avail: NTIS HC A02/MF A01

Presented are the results of thermal cycling tests carried out on rare earth compounds (REC) and NdFe samples, to determine the irreversible losses in room temperature open circuit magnetic moment. A stabilization prescription was developed for a REC alloy that will allow two 4 day/175C temperature cycles, which simulate two UHV bakeouts, with only a 0.35% average loss and a 0.65% loss variation in the room temperature open circuit magnetic moment after stabilization. DOE

N86-29618# Lawrence Livermore National Lab., Calif.
PROGRESS IN DIAMOND CELL EXPERIMENTS: PRESSURED ABOVE THREE MEGABARS
K. A. Goettel, R. Reichlin, W. C. Moss, and S. Martin 23 Jan. 1986 4 p Presented at the Lunar and Planetary Science Conference, Houston, Tex., 17 Mar. 1986 Prepared in cooperation with Brown Univ., Providence, R.I.
(Contract C-W-7405-eng-48)
(DE86-006726; UCRL-93975; CONF-860375-1) Avail: NTIS HC A02/MF A01

Diamond cell experiments at pressures above 2 megabars have many important applications with respect to planetary interiors (e.g., metallization of hydrogen). To make possible acquisition of data at extreme pressures on materials of planetary interest, we have been exploring both numerically and experimentally several aspects of diamond cell design and methodology. We have conducted detailed finite element analyses of the diamond cell to explore how bevelled anvils and material properties of the gasket affect diamond cell performance. These calculations include nonlinear equations of state, gasket plasticity, and diamond-gasket interfacial friction. Gasket plasticity has a dramatic effect on the stress field and thus must be included in any physically realistic analysis of the diamond cell. Purely elastic calculations, therefore, cannot model adequately the behavior of a diamond cell. Gasket yield strengh is very important in facilitating generation of extreme pressures in a diamond cell. Increasing gasket yield strength allows a higher radial pressure gradient to be supported at a given gasket thickness, which means that failure of an experiment by deformation of the anvils to allow anvil-anvil contact occurs at higher pressures than would occur with a lower yield strength gasket. DOE

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environment Pollution.*

N86-29619# Aeronautical Research Inst. of Sweden, Bromma.
PROCEEDINGS OF THE IEA WORKSHOP ON WIND TURBINE NOISE MEASUREMENTS
1984 187 p refs Partly in ENGLISH and DANISH Workshop held in Stockholm, Sweden, 12-13 Nov. 1984
(FFAP-110; ESA-85-95402) Avail: NTIS HC A09/MF A01

Measurement of background noise around wind turbines; masking of wind turbine noise by wind noise; acoustic source power levels of wind turbines; wind turbine noise; and tower wake effects on wind turbine noise were discussed. For individual titles, see N86-29620 through N86-29626.

N86-29620# Central Electricity Generating Board, Bristol (England). Scientific Services Dept.
MEASUREMENT METHODS USED TO DETERMINE BACKGROUND NOISE AND WIND TURBINE NOISE EMISSION AT CARMARTHEN BAY
Peter J. Narine *In* Aeronautical Research Inst. of Sweden Proceedings of the IEA Workshop on Wind Turbine Noise Measurements 1984 19 p (For primary document see N86-29619 20-71)
Avail: NTIS HC A09/MF A01

A system to measure background noise around a prototype 250 kW wind turbine was developed. Permanent microphones controlled by a microprocessor (PANDORA system) provide automatic data samples to characterize background noise and noise emissions, which exhibit high variability. The system consists of 4 microphones 50 m from the turbine (2 sonic and 2 infrasonic) and a single microphone (sonic) adjacent to residences 600 m from the turbine. Noise data are obtained at intermediate distances using portable equipment. Results establish the relationship between background noise (wind noise floor) versus wind speed. Noise emission characteristics from mechanical and aerodynamic sources are described in dB(A), 1/3 octave band, and discrete frequency terms. The PANDORA system was employed to determine the variation of background noise levels inside residences with wind speed and direction. ESA

N86-29621# IFM Akustibyran A.B., Stockholm (Sweden).
MASKING OF WIND TURBINE NOISE BY WIND NOISE
Ove Bennerhult *In* Aeronautical Research Inst. of Sweden Proceedings of IEA Workshop on Wind Turbine Noise Measurements 1984 10 p (For primary document see N86-29619 20-71)
Avail: NTIS HC A09/MF A01

Wind noise produced in tree and building measurements was measured in two areas to judge to what extent noise from wind turbines is masked by wind noise. The first place corresponds to a rural area. Buildings are low and thinly scattered. The trees are principally high hardwood. The second place is a suburb with large gardens. The vegetation consists of hedges, bushes, fruit trees, and high hardwoods. The wind speed varies in the range of 3 to 10 m/sec at a height of 7 m. It is not possible to draw conclusions about the shape of the frequency spectrum of the external wind noise in the low frequency region, below 250 Hz. For higher frequencies 1/3 octave band spectra are reliable and are almost independent of frequency; a slight decrease with frequency of 1 dB/octave can be observed in the frequency range of 250 to 4000 Hz. ESA

N86-29622# Technische Physische Dienst TNO-TH, Delft (Netherlands). Inst. of Applied Physics.
DETERMINATION OF THE ACOUSTIC SOURCE POWER LEVELS OF WIND TURBINES
Alex deBruijn, W. J. Stam (Netherlands Energy Research Foundation, Petten.), and W. B. deWolf (National Aerospace Lab., Emmeloord, Netherlands) *In* Aeronautical Research Inst. of Sweden Proceedings of the IEA Workshop on Wind Turbine Noise Measurements 1984 11 p (For primary document see N86-29619 20-71)
Avail: NTIS HC A09/MF A01

To facilitate Wind Energy Conversin System (WECS) licensing, it is recommended to obtain the immission-relevant sound power from the WECS, since this quantity fits into most recommendations for industrial installations. Measurements on small and medium-scale WECS show that rotor rotation speed is a more important parameter than the wind velocity with regard to the radiated noise. An acoustic telescope was used to identify noise sources on two medium-size wind turbines. The mechanical

noise from the nacelle is mostly predominant but the trailing edge aerodynamic noise is not negligible. A prediction model for this type of noise, which leads to good agreement with experimental data was developed. A method to suppress turbulence signals around WECS is a set-up with twin microphones, using correlation techniques on both signals. ESA

N86-29623# Gesamthochschule, Kassel (West Germany).
NOISE MEASUREMENTS AT THE WIND ENERGY CONVERTER (WEC) GROWIAN
B. Hoffman and F. Koerber (Maschinenfabrik Augsburg-Nuernberg A.G., Munich (West Germany).) *In* Aeronautical Research Inst. of Sweden Proceedings of the IEA Workshop on Wind Turbine Noise Measurements 1984 16 p (For primary document see N86-29619 20-71)
Avail: NTIS HC A09/MF A01

The A-weighted sound level around the GROWIAN wind turbine was measured at standstill, no load operation, and rated power conditions. The equivalent continuous noise level and percentages levels near GROWIAN were taken over several hours at standstill and rated power. The 1/3 octave band data clarify primary sound sources. Comparison of standstill and rated power data show that sound caused by the gear and the blades is of the same intensity. Gear noise dominates, however, because of its audible tone components. Atmospheric parameters, and generator output and speed were measured. Radiated sound level data were obtained, in spite of atypical wind velocity and direction. ESA

N86-29624# Danish Boiler Owners Association, Soeborg.
NOISE MEASUREMENTS AROUND THE NIBE (DENMARK) WIND TURBINES AND THE WINDANE 31 WIND TURBINE
Joergen Kristensen *In* Aeronautical Research Inst. of Sweden Proceedings of the IEA Workshop on Wind Turbine Noise Measurements 1984 28 p In ENGLISH and DANISH (For primary document see N86-29619 20-71)
Avail: NTIS HC A09/MF A01

Noise around the two 640 kW wind turbines, and a 300 kW wind turbine at various distances and wind velocities was measured. The results are stated partly as the energy equivalent, A-weighted sound pressure level as a function of the wind velocity, partly as frequency analyses based on tape recordings of the A-weighted sound pressure level. A subjective evaluation of the noise emission from the wind turbines is given. ESA

N86-29625# IFM Akustibyran A.B., Stockholm (Sweden).
MEASUREMENTS OF NOISE EMISSION AROUND SWEDISH TURBINES
Tommy Zetterling *In* Aeronautical Research Inst. of Sweden Proceedings of the IEA Workshop on Wind Turbine Noise Measurements 1984 22 p (For primary document see N86-29619 20-71)
Avail: NTIS HC A09/MF A01

Noise around two wind turbine prototypes and around buildings 2 km from the machines was measured. Results show that equipment for the low frequency range has an unsatisfactory high noise level for this type of measurement, since it is designed to measure sonic booms with pressure levels far from 100 dB. However, no other system for the frequency range below 2 to 3 Hz was found. It can be questioned if it is necessary to perform measurements below 2 Hz to judge acoustic quality. Measurements and analyses in the frequency range above 2 Hz were carried out without problems. ESA

N86-29626# Aeronautical Research Inst. of Sweden, Bromma.
MEASUREMENT OF THE TOWER WAKE OF THE SWEDISH PROTOTYPE WIND ENERGY CONVERSION SYSTEM (WECS) MAGLARP (SWEDEN) AND CALCULATIONS OF ITS EFFECT ON NOISE AND BLADE LOADING
Kenneth Barman, Jan-Aake Dahlberg, and Staffan Meijer *In its* Proceedings of the IEA Workshop on Wind Turbine Noise Measurements 1984 9 p Presented at European Wind Energy Conference, Hamburg, West Germany, Oct. 1984 (For primary document see N86-29619 20-71)
Avail: NTIS HC A09/MF A01

Hot-wire measurements of the velocity deficit in the wake behind the tower of a wind turbine are presented. The measurements were performed at one height and at three distances from the tower center when the turbine was not running. The low frequency noise caused by the passage of a turbine blade through the wake of the tower is calculated using wake data from the measurements. A comparision with noise emission measurements is included. The variation in blade loading and turbine power output caused by the wake are also calculated. Results show that wake deficits can be of the same order of magnitude as the freestream velocity. ESA

N86-29627# Shock and Vibration Information Center (Defense), Washington, D. C.
THE SHOCK AND VIBRATION DIGEST, VOLUME 17, NO. 12 Monthly Report
Judith Nagle-Eshleman, ed. Dec. 1985 193 p
(AD-A164990) Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20/1

Topics addressed include: acoustic emissions from wire and synthetic ropes; turbulent flow noise mechanisms; book reviews; and abstracts from current literature. For individual titles, see N86-29628 through N86-29629.

N86-29628# Institute of Applied Mechanics, Puerto Belgrano Naval Base (Argentina).
ACOUSTIC EMISSIONS FROM WIRE AND SYNTHETIC ROPES
P. A. A. Laura *In* Shock and Vibration Information Center (Defense) The Shock and Vibration Digest, Volume 17, No. 12, Dec. 1985 p3-6 (For primary document see N86-29627 20-71)
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20/1

The rupture of mechanical cables used in towing operations, remote control of equipment, and salvage operations can result in loss of both life and equipment. Accordingly, reliable and simple methods to assess the structural integrity of mechanical cables are of utmost importance. Applications of the acoustic emission method is reviewed from the point of view of the nondestructive evaluation of wire and synthetic ropes and monitoring their mechanical status while in operation. Author

N86-29629# Minnesota Univ., Minneapolis. Hydraulic Lab.
RECENT RESEARCH ON TURBULENT FLOW NOISE MECHANISMS
D. F. Long and R. E. A. Arndt *In* Shock and Vibration Information Center(Defense), The Shock and Vibration Digest, Volume 17, No.1 2, Dec. 1985 p 7-15 (For primary document see N86-29627 20-71)
Avail: SVIC, Code 5804, Naval Research Lab., Washington, D.C. 20375 CSCL 20/1

The pressure field generated by large-scale coherent motions in turbulent flows is examined. A general decompostion is discussed that evaluates the magnitude of the coherence in an unbiased way. The tool is described in terms of two flows of current interest, jets and boundary layers. Author

N86-29630*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MODELING THE EFFECTS OF WIND TUNNEL WALL ABSORPTION ON THE ACOUSTIC RADIATION CHARACTERISTICS OF PROPELLERS
Kenneth J. Baumeister and Walter Eversman (Missouri Univ., Rolla.) Jul. 1986 21 p Presented at the 10th Aeroacustics Conference, Seattle, Wash., 9-11 Jul. 1986; sponsored by AIAA
(NASA-TM-87333; E-2812; NAS 1.15:87333; AIAA-86-1876) Avail: NTIS HC A02/MF A01 CSCL 20A

Finite element theory is used to calculate the acoustic field of a propeller in a soft walled circular wind tunnel and to compare the radiation patterns to the same propeller in free space. Parametric solutions are present for a 'Gutin' propeller for a variety of flow Mach numbers, admittance values at the wall, microphone position locations, and propeller to duct radius ratios. Wind tunnel boundary layer is not included in this analysis. For wall admittance

nearly equal to the characteristic value of free space, the free field and ducted propeller models agree in pressure level and directionality. In addition, the need for experimentally mapping the acoustic field is discussed. Author

N86-29631*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
AN OUTFLOW ACOUSTIC BOUNDARY CONDITION FOR INTERNAL DUCT FLOWS
Marianne Mosher Feb. 1986 24 p
(NASA-TM-86708; Rept-86105; NAS 1.15:86708) Avail: NTIS HC A02/MF A01 CSCL 20A

A boundary condition for the linear acoustic equation has been developed that allows the acoustic pressure waves to propagate out of the computational domain boundary, just as they would propagate in an infinitely long duct. The problem is divided into two domains: numerical and analytical. The boundary condition provides a matching of the two domains. Examples show this method works well in an acoustic panel program for a model problem (simple source in a rectangular duct with several propagating modes present). The boundary condition is described so that it can be used with various duct various duct geometries and numerical methods. Author

N86-29632*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INTERACTION OF AIRBORNE AND STRUCTUREBORNE NOISE RADIATED BY PLATES. VOLUME 2: EXPERIMENTAL STUDY
Michael C. McGary Jul. 1986 36 p
(NASA-TM-87747; NAS 1.15:87747) Avail: NTIS HC A03/MF A01 CSCL 20A

The interaction of airborne and structureborne noise radiated by aircaraft materials was studied. The results corroborate the findings of an earlier analytical study by showing that the noise radiation of vibrating plates due to combined airborne and structureborne inputs possesses a stong synergistic nature. The large influence of the interaction between the airborne and structureborne inputs was hitherto ignored by researchers of aircraft interior noise problems. Author

N86-29633*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
INTERACTION OF AIRBORNE AND STRUCTUREBORNE NOISE RADIATED BY PLATES. VOLUME 1: ANALYTICAL STUDY
Michael C. McGary Jul. 1986 61 p
(NASA-TM-87746; NAS 1.15:87746) Avail: NTIS HC A04/MF A01 CSCL 20A

The interaction of airborne and structureborne noise radiated by aircraft materials was examined. The theory and results of several computer simulations of the noise radiated by thin, isotropic, rectangular aluminum plates due to fully coherent combined acoustic and vibrational inputs is presented. The most significant finding was the extremely large influence that the relative phase between inputs has on the combined noise radiation of the plates. Phase dependent effects manifest themselves as cross terms in both the dynamic and acoustic portions of the analysis. Computer simulations show that these cross terms can radically alter the combined sound power radiated by plates constructed of aircraft-type materials. The results suggest that airborne-structureborne interactive effects could be responsible for a significant portion of the overall noise radiated by aircraft-type structures in the low frequency regime. This implies that previous analytical and experimental studies may have neglected an important physical phenomenon in the analayses of the interior noise of propeller dirven aircraft. Author

N86-29634# Delaware Univ., Newark. College of Marine Studies.
STUDY OF THE EFFECT OF FLOCS ON ACOUSTIC SCATTERING AND TRANSMISSION IN SEAWATER Final Report
Ronald J. Gibbs 14 Feb. 1986 10 p
(Contract N00014-83-K-2019)
(AD-A165894) Avail: NTIS HC A02/MF A01 CSCL 20/1

In the ocean the primary particle size of the sediments in the water column and on the bottom is 1 to 2 micrometer in diameter. However, in the high salt concentration of the ocean these primary particles are attracted to each other to form flocs. The effect of these flocs on the scattering and transmission of sound in the ocean is unknown. This paper presents laboratory measurements of scattering of ultrasound from flocs at various stages of formation. These data are used to estimate the effect these flocs have on sound transmission and scattering, and to evaluate the possibility of using sound to study flocs in the oceans. GRA

N86-29635# Lawrence Livermore National Lab., Calif.
FAST ULTRASONIC IMAGING IN A LIQUID FILLED PIPE
W. F. Kolbe, B. T. Turko, and B. Leskovar Oct. 1985 11 p Presented at the IEEE Nuclear Science Symposium, San Francisco, Calif., 23 Oct. 1985
(Contract DE-AC03-76SF-00098)
(DE86-004100; LBL-19207; CONF-851009-33) Avail: NTIS HC A02/MF A01

A new method is described for the imaging of the interior of a liquid filled metallic pipe using acoustical techniques. The experimental system incorporates an array of 20 acoustical transducers and is capable of capturing the images of moving bubbles at a frame rate in excess of 300/s. The transducers are mounted circumferentially around the pipe. Each transducer is pulsed in sequence, and the echoes reflected from vapor bubbles in the interior are detected, digitized and processed by a computer to generate an image. The high rate of speed was achieved by the use of newly developed software and electronic circuitry. This approach has eliminated most of the spurious echo signals which degraded the performance of previous imaging systems. The capability of the method is illustrated by imaging actual vapor bubbles in rapid sequence in the pipe. DOE

N86-29636# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.
A STUDY ON THE TRANSMISSION OF SOUND THROUGH FLOW DUCTS OF VARYING CROSS SECTION
S. W. Rienstra 15 Oct. 1983 50 p
(Contract NIVR-311.4-1946)
(NLR-TR-83128-U; B8660348; ESA-86-97503) Avail: NTIS HC A03/MF A01

Sound propagation through axially varying ducts with mean flow is studied. Analytical theories for low and high frequencies are derived. A computer program for Nayfeh's (1980) wave envelope approach was tested to see if bottlenecks could be identified, what parameter range is attainable, and to what extent the classical uniform duct model produces satisfactory results. Although in principle amenable to high frequencies and circumferential periodicities, the method has parts of purely numerical nature, which do not allow a too detailed field; for sound propagating into a contraction (the usual case in a turbo engine intake) the prediction of the uniform duct model seems to be always conservative. A spectacular increase of the reflected wave is found for a combination of high Mach number and thin boundary layer in the contraction. ESA

N86-29637# Southwest Research Inst., San Antonio, Tex.
PROGRAM FOR FIELD VALIDATION OF THE SYNTHETIC APERTURE FOCUSING TECHNIQUE FOR ULTRASONIC TESTING (SAFT UT) Final Report
D. R. Hamlin Nov. 1985 170 p
(Contract NRC-FIN-B5605; SwRI Proj. 17-5023)
(TI86-900627; NUREG/CR-4078) Avail: NTIS HC A08/MF A01

This final report describes work performed by Southwest Research Institute for the Nuclear Regulatory Commission (NRC) in fulfillment of NRC Contract No. NRC-04-77-145; 'Program for Field Validation of the Synthetic Aperture Focusing Technique for Ultrasonic Testing (SAFT UT).' The purpose was to validate the effectiveness of SAFT UT as a nondestructive examination technique for nuclear power and other related industries. SAFT UT is an ultrasonic imaging method for accurate measurement of the spatial location and extent of acoustically reflective surfaces

(flaws) contained in objects such as structural components and weldments in nuclear power reactor systems. The increased measurement accuracy offered by SAFT, when compared with that provided by measurement methods now in use, will improve the reliability of flaw severity assessment with resultant safety and economic benefits to the nuclear power industry. This report presents a comprehensive discussion of the work accomplished in evaluating the performance capabilities of the developed SAFT UT inspection system. Inspection results obtained using both 0-degree longitudinal and angle-beam operating modes are presented. These results include laboratory and nuclear power plant field site examinations on a variety of defect types contained within carbon and stainless steel flat plate and cylindrical test specimens or components. The SAFT UT processed data flaw images are evaluated by comparing them to results obtained from destructive sectioning or by using flaw fabrication data which predicted actual flaw depth, orientation and size. On the basis of these evaluations conclusions are presented which summarize the performance capabilities of the SAFT UT inspection technique. Author

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure and molecular spectra.

N86-29638# Texas Univ., Austin. Dept. of Physics.
NUCLEAR STRUCTURE STUDIES USING THE HIGH RESOLUTION SPECTROMETER AT THE LOS ALAMOS CLINTON P. ANDERSON MESON PHYSICS FACILITY Progress Report
Dec. 1985 162 p
(Contract DE-AS05-80ER-10638)
(DE86-004997; DOE/ER-10638/6) Avail: NTIS HC A08/MF A01

Research which was done using the High Resolution Spectrometer (HRS) at the Los Alamos Clinton P. Anderson Meson Physics Facility (LAMPF) is examined. This research focuses on: (1) providing p + nucleus scattering data which test nonrelativistic and relativistic models of the medium energy proton + nucleus interaction, (2) providing data which are to be analyzed to provide new nuclear structure information (both ground state and excited state), (3) providing proton + nucleon data to aid in the systematic study of the fundamental nucleon-nucleon interaction, and (4) developing and improving the pA models themselves. Other efforts involve work at the Brookhaven National Laboratory and are associated with experiments studying: (1) the formation and use of hypernuclei as a new tool for nuclear structure studies, and (2) strange dibaryon resonances. DOE

N86-29639# New York Univ., New York. Dept. of Physics.
ENERGY-RELATED ATOMIC AND MOLECULAR STRUCTURE AND SCATTERING STUDIES Annual Report, 1 Jun. 1985 - 31 May 1986
B. Bederson 1986 39 p
(Contract DE-AC02-78ER-04971)
(DE86-005802; DOE/ER-04971/7) Avail: NTIS HC A03/MF A01

This is the Annual Report for the period June 1, 1985 to May 31, 1986 for Energy-Related Atomic and Molecular Structure and Scattering Studies. During the past year efforts were concentrated on two specific experiments. These were: (1) an attempt to measure the polarizability of the optically pumped excited state of thallium 6s6p sup 2 P(sub 3/2), including its tensor components, and (2) a study of the differential scattering at small angles of electrons at low energies by several alkali halide molecules. In the thallium experiment some preliminary measurements have been performed, although these were temporarily discontinued in order to update the beams machine upon which this experiment is being performed. DOE

N86-29640# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.
LOW TEMPERATURE AND NEUTRON PHYSICS STUDIES Progress Report, Jul. 1984 - Oct. 1985
Nov. 1985 6 p
(Contract DE-AC02-76ER-03342)
(DE86-005803; DOE/ER-03342/13; COO-3342-13; MIT-3342-13)
Avail: NTIS HC A02/MF A01

Experiments were carried out during the past year in which the magnetic neutrality of the neutron was explored, leading to a new upper limit value for the magnetic monopole charge of 1.3(+ or - 3.0) times 10 to the -20 power Dirac charge units. The increased sensitivity of the present experiment resulted from the exploitation of the anomalous small effective mass of neutrons in a diffracting crystal. Transverse deflections of the neutron trajectory under the action of a homogeneous magnetic field were studied in the experiment. Theoretical analysis of a new Pendelloesung-Larmor resonance action in crystal has been carried out and this suggests that pronounced intensity effects can be expected in experiments. This should lead to more sensitive studies of neutron spin-orbit scattering in crystals. Further theoretical study has been to questions of the measurement process in quantum systems and a relativistic paradox with a neutron interferometer has been examined. DOE

N86-29641# Kansas Univ., Lawrence. Dept. of Chemistry.
MANY-BODY PROCESSES IN ATOMIC AND MOLECULAR PHYSICS Progress Report, 1 Sep. 1984 - 31 Aug. 1986
S. I. Chu Feb. 1986 58 p
(Contract DE-AC02-80ER-10748)
(DE86-007032; DOE/ER-10748/6) Avail: NTIS HC A04/MF A01

Brief overviews of the research efforts of the author are given. The areas of research which are reviewed are: (1) the development of complex-coordinate coupled-channel formalisms for the treatment of energy and widths of multichannel predissociating resonance in van der Waals molecules; (2) a L(2)-complex-coordinate quasi-energy method for the treatment of photoionization of H atoms in intense magnetic fields; (3) a perturbative approach for the treatment of two-photon dissociation of heteronuclear diatomic molecules; (4) a semiclassical treatment of charge transfer reactions at low collision velocities and high beam intensities; and (5) the development of calculation technique using the L(2)-nonhermetian Floquet method. DOE

N86-29642# Oesterreichisches Forschungszentrum Seibersdorf G.m.b.H., Vienna. Technologische Unternehmensplanung.
A SEPARABLE APPROXIMATION OF THE NN-PARIS-POTENTIAL IN THE FRAMEWORK OF THE BETHE-SALPETER EQUATION
K. Schwarz (Technische Univ., Graz, Austria), J. Haidenbauer (Osaka Univ., Suita, Japan), and J. Froelich Sep. 1985 37 p Sponsored by Fonds zur Foerderung der wissenschaftlichen Forschung
(OEFZS-4331; NT-5/85; ESA-86-97068) Avail: NTIS HC A03/MF A01

The Bethe-Salpeter equation is solved with a separable kernel for the most important nucleon-nucleon partial wave states. The Ernst Shakin-Thaler method is used in the framework of minimal relativity (Blankenbeckler-Sugar equation) to generate a separable representation of the meson-theoretical Paris potential. These separable interactions, which closely approximate the on-shell and half-off-shell behavior of the Paris potential, are cast in a covariant form for application in the Bethe-Salpeter equation. The role of relativistic effects is discussed with respect to on-shell and off-shell properties of the NN-system. ESA

N86-29643# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Fisica dello Spazio Interplanetario.
PARTICLE INTERACTIONS WITH ALFVEN SOLUTIONS
C. R. Ovendon, H. A. Shah, and S. J. Schwartz Dec. 1985 20 p Sponsored by ICTP, Trieste
(IFSI-85-15; ESA-86-97099) Avail: NTIS HC A02/MF A01

Velocity and the corresponding energy changes due to nonresonant interactions of protons with Alfven solitons are computed. It is seen that the protons heat in the perpendicular direction but associated with this is a cooling in the parallel direction. ESA

N86-29644# Max-Planck-Institut fuer Stroemungsforschung, Goettingen (West Germany).
PHOTODISSOCIATION OF THE H2O IN THE FIRST ABSORPTION BANDS. DEPENDENCE OF THE OH STATE DISTRIBUTION ON THE ROTATIONAL STATE OF THE H2O MOLECULE Thesis [PHOTODISSOZIATION VON H2O IN DER ERSTEN ABSORPTIONSBANDE ABHAENGIGKEIT DER OH-ZUSTANDSVERTEILUNG VOM ROTATIONSZUSTAND DES H2O-MOLEKUELS]
D. Haeusler Nov. 1985 127 p In GERMAN
(MPIS-25/1985; ISSN-0436-1199; ESA-86-96905) Avail: NTIS HC A07/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 27

The dissociation of single rotational states of the asymmetric yield oscillation of water after optical excitation in the first absorption bands was investigated. The H2O state was prepared with a tuneable UV-laser. The specific states of the OH fragments were determined. The fragmentation strongly depends on the rotational state of the H2O-mother molecule. The experimental results were reproduced by a Franck-Condon theory; good agreement is found in the rotational and fine-structure distributions. The theoretical model shows that the fragmentation of single H2O-rotational states is independent of repulsive potential plane and photon energy. The application of this model to previous dissociation experiments demonstrates that the dissociation process can be analyzed with the Franck-Condon theory. ESA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N86-29645# Oak Ridge National Lab., Tenn.
HIGH ENERGY TRANSPORT CODE HETC
T. A. Gabriel Sep. 1985 24 p Presented at the LEP Experimenters' Workshop on Shower Simulation, Geneva, Switzerland, 29 Jan. 1985
(Contract DE-AC05-84OR-21400)
(DE86-001366; ORNL/TM-9727; CONF-850140-2-Rev) Avail: NTIS HC A02/MF A01

The physics contained in the High Energy Transport Code (HETC), in particular the collision models, are discussed. An application using HETC as part of the CALOR code system is also given. DOE

N86-29646# Sandia National Labs., Albuquerque, N. Mex.
CURRENT NEUTRALIZATION OF INTENSE LIGHT ION BEAMS IN ARGON GAS
J. A. Swegle and S. A. Slutz Dec. 1985 93 p
(Contract DE-AC04-76DP-00789)
(DE86-004853; SAND-85-1886) Avail: NTIS HC A05/MF A01

This paper describes a theoretical treatment for the current neutralization of intense ion beams propagating radially inward through the drift region of a cylindrical Applied-B diode. The drift region is bounded by conducting walls, and the beams are taken to have a current density profile that is constant across the surface transverse to the direction of propagation. The current neutralization calculation involves breaking the return current density into spatial harmonics in the transverse coordinate in such a way that the return current density vanishes at the walls. Each spatial harmonic is then shown to approximately obey a magnetic decay equation with a time constant proportional to the electrical conductivity of the gas. This conductivity is time dependent and is calculated locally from the degree of ionization and plasma heating created by the beam and the return current. Beams composed of protons and carbon ions are considered, and time of flight effects on the beam current and energy spectra are taken into account. The effects of drift region parameter variations on the time development of the conductivity and current neutralization are evaluated. DOE

N86-29647# Lawrence Livermore National Lab., Calif.
BEAM BREAKUP AND THE CONCEPTUAL DESIGN OF GUIDED AND UNGUIDED ACCELERATORS
G. J. Caporaso Oct. 1985 34 p
(Contract W-7405-eng-48)
(DE86-004907; UCID-20615) Avail: NTIS HC A03/MF A01

A series of drawings illustrate the beam breakup instability, laser guiding, quadrupole channels, phase mix damping, and a cavity model. Model equations are solved for a continuous beam breakup model. DOE

N86-29648# California Univ., Berkeley. Lawrence Berkeley Lab.
NEGATIVE ION BEAM ACCELERATION AND TRANSPORT EXPERIMENTS
W. S. Cooper, O. A. Anderson, J. Kwan, and W. F. Steele Nov. 1985 6 p Presented at the 11th Symposium on Engineering Problems in Fusion Research, Austin, Tex., 18 Nov., 1985
(Contract DE-AC03-76SF-00098)
(DE86-005234; LBL-19578; CONF-851102-67) Avail: NTIS HC A02/MF A01

The design of a negative ion beam transport system is discussed. The ion source and accelerator have produced a 1-A, 8 keV beam of H^- ions with a pulse length of 30 seconds. The beam was additionally characterized as to electron content, uniformity along the slot, emittance perpendicular to the slot, and the beam divergence. DOE

N86-29649# Chicago Univ., Ill. Dept. of Physics.
THEORETICAL HIGH ENERGY PHYSICS RESEARCH Technical Progress Report
J. L. Rosner 1985 17 p
(Contract DE-AC02-82ER-40073)
(DE86-005765; DOE/ER-40073/4) Avail: NTIS HC A02/MF A01

The research activities summarized include: neutral heavy leptons, unusual DESY and CERN events, exotic fermions in superstring models, magnetic monopoles, nonleptonic hyperon decays, heavy quark spectroscopy, supersymmetric quantum mechanics and inverse scattering. SU(3) breaking and the H dibaryon, P-wave mesons with one heavy quark, CP violation, magnetic moments of baryons, dynamical mass gene ration, lattice gauge theories that include fermions, modification of quantum mechanics to include a fundamental length, speculation concerning physics near the Planck scale, novel physics possibilities of hadron colliders, inclusive structure functions in e(+) e(-) colliders especially at the Z resonance, and global structure of supermanifolds. DOE

74 OPTICS

Includes light phenomena.

N86-29650*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MULTISPECTRAL LINEAR ARRAY MULTIBAND SELECTION DEVICE Patent
Herbert L. Richard Issued 8 Jul. 1986 8 p Filed 2 May 1984 Supersedes N84-25016 (22 - 15, p 2335)
(NASA-Case-GSC-12911-1; US-Patent-4,599,001; US-Patent-Appl-SN-606426; US-Patent-Class-356-419; US-Patent-Class-356-402; US-Patent-Class-350-315; US-Patent-Class-350-318) Avail: US Patent and Trademark Office CSCL 20F

An apparatus for detecting multiple spectral bands, individually or concurrently, using linear detector arrays is described. The system employs a beamsplitter to divide the optical source into two or more optical beams which are directed at the linear detector arrays. Filter trays are positioned in the focal planes of the optical beams so that the beams pass through the filter trays prior to impinging upon the detector arrays. Multiple filters are placed on the filter trays. Linear actuators positioned adjacent the filter trays translate the trays across the focal planes of the optical beams

so that individual filters are positioned in the path of beams such that those frequencies of the beams that fall within the spectral ranges of the individual bandpass filter through which it passes may be detected by the detector arrays for further examination and analysis. Author

N86-29651*# Purdue Univ., West Lafayette, Ind. School of Aeronautics and Astronautics.
OPTIMAL COOPERATIVE CONTROL SYNTHESIS OF ACTIVE DISPLAYS Final Report
Sanjay Garg and David K. Schmidt 22 Oct. 1985 160 p
(Grant NAG2-228)
(NASA-177102; NAS 1.177102) Avail: NTIS HC A08/MF A01 CSCL 20F

A technique is developed that is intended to provide a systematic approach to synthesizing display augmentation for optimal manual control in complex, closed-loop tasks. A cooperative control synthesis technique, previously developed to design pilot-optimal control augmentation for the plant, is extended to incorporate the simultaneous design of performance enhancing displays. The technique utilizes an optimal control model of the man in the loop. It is applied to the design of a quickening control law for a display and a simple K/s(2) plant, and then to an F-15 type aircraft in a multi-channel task. Utilizing the closed loop modeling and analysis procedures, the results from the display design algorithm are evaluated and an analytical validation is performed. Experimental validation is recommended for future efforts. Author

N86-29652*# Stanford Univ., Calif. Computer Systems Lab.
RESEARCH IN HIGH SPEED FIBER OPTICS LOCAL AREA NETWORKS Technical Report, 1 Jan. 1985 - 28 Feb. 1986
Fouad A. Tobagi Feb. 1986 19 p
(Grants NAG2-292; NAGW-419)
(NASA-CR-176998; NAS 1.26:176998; CASIS-D300-1986-1) Avail: NTIS HC A02/MF A01 CSCL 17B

The design of high speed local area networks (HSLAN) for communication among distributed devices requires solving problems in three areas: the network medium and its topology, the medium access control, and the network interface. Considerable progress was already made in the first two areas. Accomplishments are divided into two groups according to their theoretical or experimental nature. A brief summary is given. Author

N86-29653# Spectron Development Labs., Inc., Albuquerque, N. Mex.
MASTER OSCILLATOR AND DIAGNOSTIC UNIT DESIGN Final Report, 7 May 1984 - 8 Jan. 1985
F. C. Way and D. F. Schaack Jan. 1986 72 p
(Contract F29601-84-C-0043)
(AD-A165626; Rept-85-2383-12; AFWL-TR-85-16) Avail: NTIS HC A04/MF A01 CSCL 20/6

This report describes the design and development of a Dye Laser operating at 353 nm and an associated beam diagnostics unit capable of measuring UV phase, intensity and energy. The dye laser consists of a flashlamp pumped oscillator, including spatial and temporal mode selectors and a wavelength tuning device. The output of the oscillator at 706 nm is amplified by a flashlamp pumped dye amplifier. The resulting output is frequency doubled to 353 nm via a second harmonic generator (SHG). A pulse slicer is incorporated prior to the SHG to allow pulsewidth selectivity. The diagnostic unit was designed and fabricated to be versatile and rugged. Near-field phase and intensity and far-field intensity are photographically recorded, and energy and pulsewidth are monitored by the device. GRA

N86-29654# Letterman Army Inst. of Research, San Francisco, Calif.
A PORTABLE SOLID STATE DARK ADAPTOMETER Final Report
Gary A. Wheeler and Harry Zwick Oct. 1985 28 p
(AD-A165914; LAIR-LN-85-55) Avail: NTIS HC A03/MF A01 CSCL 06/12

Many technological advances produced the field-portable dark adaptometer. The LED light source provides an inexpensive, rugged and entirely portable alternative to conventional illumination sources. Microcomputer technology facilitated dark adaptometry data acquisition and analysis. Further refinements in the microcomputer industry have produced smaller, truly portable, and relatively inexpensive computers with the IEEE-488 communications interface standard. The IEEE-488 interface, in turn, is a powerful tool for streamlining the clinical dark adaptometer. Its power and utility come from its inherent ability to maintain communications among many devices concurrently and from the wide availability of IEEE-488 support products. These technologies are integrated in this dark adaptometer to produce a unit that is a compact and rugged alternative to laboratory and clinical visual function test equipment, and brings new sophistication to visual function diagnosis in field work. Author (GRA)

N86-29655# Purdue Univ., West Lafayette, Ind. Dept. of Physics.
STUDY OF THE INTERACTION OF LIGHT WITH SUB-MICRON METALLIC SURFACES Progress Report
R. Reifenberger Oct. 1985 6 p
(Contract DE-FG02-84ER-45162)
(DE86-004709; DOE/ER-45162/1) Avail: NTIS HC A02/MF A01

This research project is devoted to the study of the interaction of laser light with sub-micron metallic surfaces. The fundamental physical process studied is the photoexcitation of electrons from field emission tips by a focussed Argon-ion laser beam tuned to operate at a particular wavelength. The photoexcited electrons escape into the vacuum by tunnelling through a surface potential barrier which is distorted by the application of a strong electric field. The interest in these experiments lies in the information derived from a study of the final state energy distribution. The shape of this distribution should be influenced by the electronic structure of the solid under study, the quantum mechanical transmission of the electron through the surface potential barrier and the nature of the photoexcitation process of low photon energies (tau omega less than phi). This research is attempting to address all of these issues. The basic information gained from this research should be relevant for the better design and fabrication of opto-electronic and infrared devices which rely on strong interface electric fields for proper performance. fields for proper performance. DOE

N86-29656# Lawrence Livermore National Lab., Calif.
INJECTOR MODELING AND ACHIEVEMENT/MAINTENANCE OF HIGH BRIGHTNESS
J. K. Boyd Oct. 1985 41 p
(Contract W-7405-eng-48)
(DE86-004906; UCID-20619) Avail: NTIS HC A03/MF A01

Viewgraphs for the workshop presentation are given. The presentation has three fundamental parts. In part one the need for numerical calculations is justified and the available computer codes are enumerated. The capabilities and features of the DPC computer code are the focal point in this section. In part two the injector design issues are discussed. These issues include such things as the beam optics and magnetic field profile. In part three the experimental results of two injector designs are compared with DPC predictions. DOE

N86-29657# Oak Ridge Y-12 Plant, Tenn.
EFFECTS OF MACHINING PARAMETERS AND OPTICAL ALIGNMENT IN OFF-CENTERED CONIC MIRRORS
R. C. Yoder 16 Dec. 1985 53 p
(Contract DE-AC05-84OS-21400)
(DE86-005108; Y-2342) Avail: NTIS HC A04/MF A01

Expressions are derived in simple, closed form (in terms of the aperture coordinates) for the optical signatures resulting from misalignment and from several controllable machining parameters in the manufacture of diamond-turned mirrors of the type comprising conic sections of revolution. Limited in validity to the lowest order in terms of the magnitudes of both angular misalignment and machining parameters, these wavefront error expressions are

generally valid for optics of arbitrarily wide aperture. Through control of these signatures, dynamically induced part distortions can, in some cases, be eliminated. DOE

N86-29658# EG and G Energy Measurements, Inc., San Ramon, Calif.
HIGH-SPATIAL-RESOLUTION STREAK IMAGE TUBE
C. K. Hinrichs and R. W. Olsen Dec. 1985 26 p Presented at the Meeting of the Plasma Physics Division of the American Physical Society, San Diego, Calif. 4 Nov. 1985
(Contract DE-AC08-83NV-10282)
(DE86-005736; EGG-10282-4049; CONF-851136-5) Avail: NTIS HC A03/MF A01

A new streak tube was designed to provide improved spatial resolution across a large-diameter photocathode to obtain more spatial information. The first version of the tube did not employ an accelerator electrode. Tube design goals were achieved when operating at 30 kV. Spatial resolutions of 19 line pairs per millimeter (lp/mm) or better were measured across a 1-in.-diameter photocathode at one focus voltage providing 500 lp of limiting resolution, and measured time resolutions of 62 to 100 ps, depending on the wavelength of illumination. The electronic resolution is limited by chromatic aberrations to about 57 lp/mm; the overall tube resolution is limited to about 30 lp/mm by the 2-micron phosphor particle size used in the screen. In the second design, an accelerator electrode was placed in close proximity to the cathode to rapidly accelerate the photoelectrons. The chromatic aberration was dramatically reduced and the limiting time resolution was reduced to about 3 ps, making this version useful for inertial confinement fusion experiments. Reduction of the chromatic aberration all ows good resolution at further off-axis positions so that a 2-in. photocathode can be used, approximately doubling the number of line pairs of resolution to about 1000. Detailed tube characteristics are provided herein. DOE

N86-29659# University of Southern California, Los Angeles. Center for Laser Studies.
SPECTRAL ABSORPTION STUDIES OF VISIBLE MATERIALS Final Report
M. Bass and R. T. Swimm 1986 9 p
(Contract W-7405-eng-48)
(DE86-006718; UCRL-15734) Avail: NTIS HC A02/MF A01

Results of studies of optical absorption in twelve thin-film optical coatings at 482 nm wavelength, surface and bulk absorption in sapphire throughout the visible and near IR, and initial measurements in KDP are described. Laser calorimetry was carried out at room temperature, using an unfocused laser beam at normal incidence. All thin-film absorption data yielded values of P(sub abs)/P(sub inc) in the range 3 x 10 to the -4 to 3 x 10 to the -3 power at a wavelength of 482 nm. Sapphire absorption showed Urbach-tail behavior at 350 nm to 1300 nm. The range of absorption, being far lower than usual, extends the range of application of Urbach's rule. Finally, KDP measurements were attempted, but surface degradation due to the hydroscopic nature of the samples resulted in excessive light scatter. DOE

N86-29660# Lawrence Livermore National Lab., Calif.
NONLINEAR OPTICS AND SURFACE SCIENCE
Y. R. Shen Nov. 1985 14 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985
(Contract DE-AC03-76SF-00098)
(DE86-006293; LBL-20064; CONF-851217-48) Avail: NTIS HC A02/MF A01

The recent status of applications of nonlinear optics to surface science is reviewed. The basic theory of wave mixing on a surface layer, and the possibility of using various nonlinear optical processes for surface probing are briefly discussed. Emphasis is on surface second harmonic generation, which is shown with many illustrations to be a rather unique and versatile tool for surface studies. DOE

N86-29661# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Abt. Infrarottechnik.
SIMULATION OF THE INFLUENCE OF ATMOSPHERIC PARAMETERS ON INFRARED TARGET SIGNATURE
Rudolf Richter Dec. 1985 60 p
(DFVLR-Mitt-86-03; ISSN-0176-7739; ESA-86-97453) Avail: NTIS HC A04/MF A01; DFVLR, Cologne, West Germany, DM 19.50

The radiation temperature of targets is studied as a function of horizontal range for different target temperatures and atmospheric conditions. The atmospheric infrared window regions 3 to 5 and 8 to 14 microns are investigated simulating AGA 680 cameras as sensors. Atmospheric parameters are summer/winter atmospheres, rural/maritime aerosols, humidity, and meteorological range. Target/background contrast of radiation temperature is given as a function of the chosen atmospheric and range parameters. Target detection probabilities for simple homogeneous backgrounds can be calculated from the results. ESA

N86-29662# Ecole Polytechnique, Palaiseau (France). Lab. d'Optique Appliquee.
GYROMETRY USING PASSIVE RESONANT CAVITIES (SUPPLEMENT) [GYROMETRIE A CAVITE RESONNANTE PASSIVE (SUPPLEMENT)]
B. Prade and B. Lamouroux 17 Dec. 1985 16 p In FRENCH
(Contract DRET-81-495)
(ESA-86-97205) Avail: NTIS HC A02/MF A01

The development of a single mode coupler to form a resonant cavity with an optical fiber ring is described. A 0.6328 micron wavelength monomode fiber with a 8 micron core diameter was planed in a V groove machined in a 50 mm diameter silica cylindrical body. The manufacturing and control of the optical coupler are detailed. It is shown that this technique is reliable. The optical systems that can be implemented by the described method are discussed. ESA

N86-29663# Ecole Nationale Superieure des Telecommunications, Paris (France). Dept. Electronique et Physique.
LIGHT SIGNAL AMPLIFICATION USING THE NONLINEAR EFFECT OF THE FOUR PHOTON MIXING TYPE IN SINGLE MODE OPTICAL FIBERS Ph.D. Thesis [AMPLIFICATION DE SIGNAUX LUMINEUX EXPLOITANT L'EFFET NON LINEAIRE DU TYPE 'MELANGE A QUATRE PHOTONS' DANS LES FIBRES OPTIQUES NUMERIQUES]
Emma Randrianandrasana Sep. 1985 208 p In FRENCH
(ENST-85E009; ISSN-0751-1353; ESA-86-97213) Avail: NTIS HC A10/MF A01

Expressions for parametric gain and amplification are derived from coupled wave equations in case of single mode fibers. With high peak pump power (95 watt) a gain as high as 33 dB is obtained for 85.7 microwatt input power signal at 1.57 microns wavelength in a 29 m long single mode fiber. Phase matching is finely tuned using temperature effects. ESA

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics*. For space plasmas see *90 Astrophysics*.

N86-29664# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ISOTOPIC ENRICHMENT IN A PLASMA CENTRIFUGE
E. DelBosco, R. S. Dallaqua, G. O. Ludwig, and J. A. Bittencourt May 1986 15 p Sponsored by Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil) Submitted for publication
(INPE-3894-PRE/936) Avail: NTIS HC A02/MF A01

High rotational velocity and centrifugal isotopic separation of carbon in a vacuum-arc plasma centrifuge are presented. Enrichments of up to 390% for C-13 are measured at 6 cm radius with angular rotation frequencies in excess of 100,000 rad/s in an axial magnetic field of 0.12T. Author

N86-29665# Nagoya Univ. (Japan).
PROCEEDINGS OF TOPICAL MEETING ON PARTICLE BEAM FUSION AND ITS RELATED PROBLEMS, VOLUME 2
Keishiro Niu, ed. Mar. 1986 121 p Proceedings held in Nagoya, Japan (no dates given)
(IPPJ-769-(2)-Vol-2) Avail: NTIS HC A06/MF A01

Topics addressed include: pulsed power technique; pulsed ion beam extraction; plasma focus diode; proton beam focusing; ablation process of ion beam targets; inductive postacceleration of high neutralized, intense pulsed ion beams, light ion beam fusion; and pellet compression schemes. B.G.

N86-29666# Nagoya Univ. (Japan). Inst. of Plasma Physics.
EXPERIMENTAL CHARACTERISTICS OF ION BERNSTEIN WAVE HEATING ON JIPP T-2U TOKAMAK
Y. Ogawa, K. Kawahata, R. Ando, E. Kato, T. Watari, Y. Hirokura, Y. Kawasumi, S. Morita, K. Sato, S. Tanahashi et al Mar. 1986 28 p
(IPPJ-770) Avail: NTIS HC A03/MF A01

The directly launched Ion Berstein Wave (IBW) heating experiments were carried out on JIPP T-IIU tokamak for two experimental conditions: the 3rd branch of the IBW between the 3rd and 4th cyclotron harmonics of the deuterium, and the 2nd branch of the IBW between the 2nd and 3rd cyclotron harmonics. In the first case, the direct hydrogen heating at omega = 1.5 OMEGA sub H was found in previous experiments. Additional data is presented to support this subharmonics heating. While, in the second case, the remarkable increase of the electron temperature was observed, especially at the central region of the plasma, and it was estimated from the global energy balance that almost all of IBW power is delivered to the electron. To investigate this difference of the heating mode, the power absorption was calculated with the ray tracing code, taking into account the effect of the plasma/antenna coupling. It is concluded from the consideration of the electron Landau damping that the transition from the ion heating mode to the electron mode would be explained by the difference of the electron temperature at the ohmic phase; i. e., T sub e (0) = 0.7 keV for the first case and T sub e (0) = 1.3 keV for the second case. Author

N86-29667# Nagoya Univ. (Japan). Inst. of Plasma Physics.
SUSTAINING A STEADY-STATE FIELD-REVERSED CONFIGURATION
Masao Okamoto May 1986 22 p
(IPPJ-771) Avail: NTIS HC A02/MF A01

A method is considered to sustain the steady-state field-reversed configuration by driving the bootstrap current. A consistent steady-state solution is obtained within a framework of one dimensional one-fluid equations including equilibrium. It is found that the amount of seed current necessary to induce the bootstrap current (or diamagnetic current) maintaining the steady state depends strongly on the transport and loss rate of plasma particles. Author

N86-29668# Nagoya Univ. (Japan). Inst. of Plasma Physics.
NON-STOCHASTIC PROMPT PROTON ACCELERATION BY FAST MAGNETOSONIC SHOCKS IN THE SOLAR PLASMA
Jun-ichi Sakai and Yukiharu Ohsawa Mar. 1986 34 p
(IPPJ-772) Avail: NTIS HC A03/MF A01

It is shown by theory and particle simulation that a quasi-perpendicular magnetosonic shock wave accelerates some resonant ions up to the speed upsilon is approximate to upsilon sub A (m sub i/m sub e) (sup 1/2) x (M sub A - 1) (sup 3/2) promptly within the order of the ion cyclotron period, 1/omega sub ci, times (m sub i/m sub e) (sup 1/2). The final maximum speed in this acceleration is independent of the ion mass, hence the kinetic energy is proportional to the ion mass. The coronal heating and proton acceleration by magnetosonic shock waves originating from the solar flares are discussed, and it is shown that this mechanism could be important in the solar plasma. Author

N86-29669# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ENERGY RELAXATION DURING TAIL-ANISOTROPY INSTABILITY IN LOWER-HYBRID CURRENT RISE
M. Yamagiwa and M. Okamoto Apr. 1986 14 p
(IPPJ-774) Avail: NTIS HC A02/MF A01

Relaxation in energy of electrons during tail-anisotropy instability in lower-hybrid current rise in a tokamak is investigated. An unstable tail distribution of electrons is obtained by solving a Fokker-Planck equation combined with the return field and rf-associated terms. Quasi-linear relaxation of such an unstable distribution under the influence of the plasma waves excited by the instability is examined by taking into account the particle loss due to the ripple of the toroidal magnetic field. It is found that the energy relaxation in short time scale of the instability leads to the inward shift of the plasma column, which is on the order of ten percent of the minor radius in magnitude. Energy loss due to field ripple in longer time scale of parallel diffusion due to lower-hybrid waves is also discussed. Author

N86-29670# Nagoya Univ. (Japan). Inst. of Plasma Physics.
EFFECT OF IN SITU CARBON COATING ON ICRF-HEATED TOKAMAK PLASMAS RELATING TO RADIATION LOSS BY IRON-IMPURITIES IN JIPP-T-2U
N. Noda, Y. Ogawa, K. Masai, I. Ogawa, R. Ando, S. Hirokura, E. Kako, Y. Taniguchi, R. Akiyama, and Y. Kawasumi Apr. 1986 18 p
(IPPJ-773) Avail: NTIS HC A02/MF A01

In-situ carbon coating was made with a glow discharge in a methane/hydrogen mixture gas. Without carbon coating, iron contamination was so severe with megawatts ion cyclotron radio frequency (ICRF) heating that the total radiation loss exceeds the rf-heating power and the electron temperature, after once heated up, decreases continuously during the latter half of 55 ms RF pulse. With carbon coating, the radiation loss is reduced to be one fifth of the RF power and the electron temperature T sub e comes to be stationary in the end of the RF pulse. As a result of this change in T sub e, total stored energy increases compared to the one obtained before the carbon coating is applied. The the effect of the carbon coating was clearly demonstated for tokamak plasmas with high power heating. Author

N86-29671# Nagoya Univ. (Japan). Inst. of Plasma Physics.
AN ICRF CURRENT DRIVE EXPERIMENT ON JIPP T-2U
R. Ando, E. Kako, Y. Ogawa, and T. Watari Apr. 1986 23 p
(IPPJ-775) Avail: NTIS HC A02/MF A01

In JIPP T-2U tokamak the fast wave current drive by five loop antennas was successfully carried out with a relatively high density plasma. The radio frequency is 40 MHz and the toroidal field is 2 kG, which corresponds to omega = 13 omega (sub cH). To exclude the effect of the inductive field, the plasma production and the start-up of the plasma current were done with ion cyclotron radio frequency (ICRF) wave only. The density and temperature of a plasma produced by the RF wave are that eta bar (sub e) is approximately 2 x 10 to the 18th power/cu m and T (sub e) is approximately 10 eV, where only the fast wave can propagate excluding out the possibility of a slow wave current drive. This density is two orders of magnitude higher than the density limit predicted for the slow wave current drive. The maximum plasma current of 3.5 kA is driven with the RF power of about 400 kW. The efficiency eta = I (sub p) eta bar (sub e) R/P (sub rf) is around 2 x 10 to the 16 power A/sq m/W, which is two orders of magnitude lower than that of recent lower hybrid current drive. A large magnetohydrodynamic oscillation is observed and the electron temperature is limited around 10 eV, although the safety factor is about 10 or more. Author

N86-29672# Nagoya Univ. (Japan). Inst. of Plasma Physics.
AVERAGING METHOD FOR STUDYING MAGNETOHYDRODYNAMIC EQUILIBRIUM AND STABILITY OF TOROIDAL HELICAL SYSTEMS
Jiro Todoroki Apr. 1986 23 p
(IPPJ-776) Avail: NTIS HC A02/MF A01

Formulae of stellarator approximation valid for finite aspect

ratio helical tori are derived by using coordinate transformation and method of averaging. The three dimensional problem of magnetohydrodynamic equilibrium and stability is reduced to two dimensional one; this makes possible conversion of tokamak codes to stellarator codes. The importance of including residual magnetic field to recover the three dimensional magnetic field from averaged equilibrium is stressed. Author

N86-29673# Systems Science and Software, La Jolla, Calif.
THE ROLES OF VxB AND DENSITY GRADIENTS IN PLASMA ELECTRIC FIELDS MEASURED FROM THE SHUTTLE ORBITER
J. R. Lilley, Jr., I. Katz, and D. L. Cooke Jun. 1985 14 p
(Contract F19628-82-C-0081)
(AD-A165230; SSS-R-85-7339; AFGL-TR-85-0257; SR-3) Avail: NTIS HC A02/MF A01 CSCL 22/1

Plasma electric fields due to motion through the geomagnetic field and to density gradients are of the same order of magnitude in the wake of shuttle sized objects. Density gradient fields dominate in the wakes of smaller satellites while vxB fields dominate behind larger structures. Supporting experimental data is cited. Computational results (calculated using the spacecraft charging code POLAR) which demonstrate the roles of the two fields in the wake are also presented. GRA

N86-29674# Naval Research Lab., Washington, D. C.
NUMERICAL SIMULATION OF A LOW DENSITY PLASMA EROSION OPENING SWITCH Interim Report
J. M. Grossmann, P. F. Ottinger, J. M. Neri, and A. T. Drobot 19 Mar. 1986 46 p
(AD-A166456; AD-E301928; NRL-MR-5724) Avail: NTIS HC A03/MF A01 CSCL 20/9

The conduction of current through a low density (approx 10 to the 12th power per cu cm) collisionless plasma injected between two coaxial conducting cylinders is simulated using a 2 1/2D, electromagnetic particle-in-cell code. Plasma is injected through the anode towards the cathode with flow velocity, VF, and is assumed to be azimuthally symmetric. Current is driven through the plasma so that the 100 kA level is reached in approx. 5 ns. The opening process, when current is diverted to a load, is also treated. Electrons are found to carry current in a narrow current channel across the plasma by E X B drift. A large electric field is established by charge separation in the plasma in order to provide the drift. The motion of the anode end of the current channel controls the time of opening and is found to be independent of VF and to depend strongly on density and length. GRA

N86-29675# Lawrence Livermore National Lab., Calif.
APPLICATIONS OF DIGITAL PROCESSING FOR NOISE REMOVAL FROM PLASMA DIAGNOSTICS
R. J. Kane, J. V. Candy, and T. A. Casper 11 Nov. 1985 6 p Presented at the 11th Symposium on Engineering Problems in Fusion Research, Austin, Tex., 18 Nov. 1985
(Contract W-7405-eng-48)
(DE86-005137; UCRL-92511; CONF-851102-73) Avail: NTIS HC A02/MF A01

The use of digital signal techniques for removal of noise components present in plasma diagnostic signals is discussed, particularly with reference to diamagnetic loop signals. These signals contain noise due to power supply ripple in addition to plasma characteristics. The application of noise canceling techniques, such as adaptive noise canceling and model-based estimation, will be discussed. The use of computer codes such as SIG is described. DOE

N86-29676# Lawrence Livermore National Lab., Calif.
DESCRIPTION OF THE PLASMA POTENTIAL CONTROL (PPC) SYSTEM ON THE TANDEM MIRROR EXPERIMENT-UPGRADE (TMX-U)
P. S. Surrena and R. H. Underwood 11 Nov. 1985 5 p Presented at the 11th Symposium on Engineering Problems in Fusion Research, Austin, Tex., 18 Nov. 1985
(Contract W-7405-eng-48)
(DE86-005142; UCRL-92513; CONF-851102-69) Avail: NTIS HC A02/MF A01

A set of 18 separately controlled plates have been added to each end of the Tandem Mirror Experiment Upgrade (TMX-U) vessel to allow measurement of end-wall currents and to provide a means of plasma potential control (PPC). These plates are shaped to form elliptical rings separated into quadrants. Each plate can be individually grounded, float at plasma potentials, or be actively biased to control the plasma. Voltage and current monitoring are provided for each of the plates, and the control and monitoring functions are controlled by the PPC system computer. The details of the field line mapping and the plate shapes are discussed, and the control architecture and performance are presented. DOE

N86-29677# Illinois Univ., Urbana. Fusion Technology Lab.
APPLICATION OF RAILGUN PRINCIPLE TO HIGH-VELOCITY HYDROGEN PELLET INJECTION FOR MAGNETIC FUSION REACTOR REFUELING Progress Report
K. Kim Jan. 1986 8 p
(Contract DE-FG02-84ER-52111)
(DE86-005153; DOE/ER-52111/T1) Avail: NTIS HC A02/MF A01

• Using a tungsten-needle arc initiator in conjunction with Paschen curves characteristics, hydrogen pellets have been accelerated with a two-stage electromagnetic railgun system. This scheme produced velocities on the order of 1.6 km/s. The effects on performance of the bore size have been studied. Questions of pretriggering, misfiring, plasma-arc stalling, railgun geometry, and railgun currents have been addressed. DOE

N86-29678# Texas Univ., Austin. Inst. for Fusion Studies.
EFFECT OF TOROIDICITY DURING LOWER HYBRID MODE CONVERSION
S. Riyopoulos and S. Mahajan Nov. 1985 23 p
(Contract DE-FG05-80ET-53088)
(DE86-005399; DOE/ET-53088/202; IFSR-202) Avail: NTIS HC A02/MF A01

The effect of toroidicity during lower hybrid mode conversion is examined by treating the wave propagation in an inhomogeneous medium as an eigenvalue problem for omega (2) = omega (2) (m,n),m,n poloidal and toroidal wave numbers. Since the frequency regime near omega (2) = omega (2) /sub LH/ is an accumulation point for the eigenvalue spectrum, the degenerate perturbation technique must be applied. The toroidal eigenmodes are constructed by a zeroth order superposition of monochromatic solutions with different poloidal dependence m, thus they generically exhibit a wide spectrum in k/sub parallel/ for given fixed omega even for small inverse aspect ratio epsilon. In case that the average <k/sub parallel/> is in the neighborhood of k/sub min/, the minimum wave number for accessibility of the mode conversion regime, it is expected that excitation of toroidal modes rather than geometric optics will determine the wave coupling to the plasma. DOE

N86-29679# Texas Univ., Austin. Inst. for Fusion Studies.
DESTABILIZATION OF MHD MODES WITH FINITE LARMOR RADIUS EFFECTS IN TANDEM MIRRORS
M. Kotschenreuther and H. L. Berk Jan. 1986 20 p
(Contract DE-FG05-80ET-53088)
(DE86-005401; DOE/ET-53088/219; IFSR-219) Avail: NTIS HC A02/MF A01

Difficulties in the stabilization of ideal magnetohydrodynamic (MHD) ballooning modes by finite Larmor radius (FLR) effects are considered, in tandem mirror geometry for azimuthal mode numbers l > 1. A kinetic formalism is used to obtain corrections to the long thin approximation, when keeping terms of quadratic order in the curvature. If eta (sub i) = delta lnT (sub i)/ delta lnn (sub i) > or = to 0, with T (sub i), n (sub i), the ion temperature and density, ion resonance effects eliminate absolute FLR stability, though the residual growth rates are substantially reduced from the MHD values. Even lowest order FLR stability is difficult to achieve with choke coils present, but is possible with a more

gradually tapered mirror. However, the residual modes are still important, and mixing length estimates of the confinement degradation from modes with $l > 1$ indicate they can still severely limit the achievement of reactor-grade operation near and above the threshold beta value predicted from the ideal MHD theory. This is most severe if the ion temperature gradient decreases radial eta (sub i) > 0, whereupon significant instabilities can even arise below the ideal threshold. However, if the ion temperature gradient can be made posititve, and -eta (sub i) $> 2/3$, the lowest order FLR theory suffices to produce stability. DOE

N86-29680# Oak Ridge National Lab., Tenn.
NEOCLASSICAL TRANSPORT FLUXES IN THE PLATEAU REGIME IN NONAXISYMMETRIC TOROIDAL PLASMAS
K. C. Shaing, S. P. Hirshman, and J. D. Callen Jan. 1986 32 p Prepared in cooperation with Wisconsin Univ., Madison
(Contract DE-AC05-84OR-21400)
(DE86-006749; ORNL/TM-9594) Avail: NTIS HC A03/MF A01

The neoclassical fluxes in the plateau regime in an arbitrary large-aspect-ratio, nonaxisymmetric toroidal system are calculated based on the moment equation approach. The results are applicable for any nonaxisymmetric system. Two specific examples, one for a stellarator, and the other one for a rippled tokamak, are considered. It is found that for most stellarators, the helical magnetic field contribution to the particle and heat fluxes is as important as the toroidicity contributions, and should not be neglected. Further, the helical magnetic field contribution to the parallel viscosity is capable of reversing the directions of the bootstrap current and Ware pinch flux, while in a rippled tokamak, the neoclassical particle and heat fluxes are the same as those in an axisymmetric tokamak after the radial electric field and parallel flow velocity are determined without the external sources. DOE

N86-29681# Princeton Univ., N. J. Plasma Physics Lab.
PROPAGATION OF ION BEAMS THROUGH A TENUOUS MAGNETIZED PLASMA
E. F. Chrien, E. J. Valeo, R. M. Kulsrud, and C. R. Oberman Oct. 1985 30 p
(Contract DE-AC02-76CH-03073)
(DE86-002527; PPPL-2100) Avail: NTIS HC A03/MF A01

When an ion beam is propagated through a plasma, the question of charge neutralization is critical to its propagation. Such a problem is considered where the plasma is magnetized with magnetic field perpendicular to the beam. The plasma-number density and beam-number density are assumed comparable. The problem is reduced to a two-dimensional model, which is then solved. The solution suggests that it should be possible to attain charge neutralization if the beam density is properly varied along itself. Author

N86-29682# Princeton Univ., N. J. Plasma Physics Lab.
THERMONUCLEAR INVERSE MAGNETIC PUMPING POWER CYCLE FOR STELLARATOR REACTORS
D. D.-M. Ho and R. M. Kulsrud Sep. 1985 47 p
(Contract DE-AC02-76CH-03073)
(DE86-002539; PPPL-2249) Avail: NTIS HC A03/MF A01

A novel power cycle for direct conversion of alpha-particle energy into electricity is proposed for an ignited plasma in a stellerator reactor. The plasma column is alternately compressed and expanded in minor radius by periodic variation of the toroidal magnetic field strength. As a result of the way a stellarator is expected to work, the plasma pressure during expansion is greater than the corresponding pressure during compression. Therefore, negative work is done on the plasma during a complete cycle. This work manifests itself as a back-voltage in the toroidal field coils, and direct electrical energy is obtained from this voltage. For a typical reactor, the average power obtained from this cycle (with a minor radius compression factor on the order of 50%) can be as much as 50% of the electrical power obtained from the thermonuclear neutrons without compressing the plasma. Thus, if it is feasible to vary the toroidal field strength, the power cycle provides an alternative scheme of energy conversion for a deuterium-tritium fueled reactor. The cycle may become an important method of energy conversion for advanced neutron-lean fueled reactors. By operating two or more reactors in tandem, the cycle can be made self-sustaining. Author

N86-29683# Lawrence Livermore National Lab., Calif.
ATOMS IN DENSE PLASMAS
R. M. More Jan. 1986 63 p Presented at the NATO Advanced Study Institute on Atoms in Unusual Situations, Cargese, France, 13 Jun. 1985
(Contract W-7405-eng-48)
(DE86-005388; UCRL-93926; CONF-8506239-2)
HC A04/MF A01

Recent experiments with high-power pulsed lasers have strongly encouraged the development of improved theoretical understanding of highly charged ions in a dense plasma environment. This work examines the theory of dense plasmas with emphasis on general rules which govern matter at extreme high temperature and density. DOE

N86-29684# TRW Space Technology Labs., Redondo Beach, Calif.
STM PROGRAM Quarterly Progress Report, Oct. - Dec. 1985
Jan. 1986 14 p
(Contract DE-AC03-85ER-51089)
(DE86-005791; DOE/ER-51089/T2) Avail: NTIS HC A02/MF A01

Improvements in the barium ion beam diagnostic system have been completed which have provided sufficient gain in signal noise to allow measurements of the diamagnetic field and space potentials in a STM hydrogen plasma. This diagnostic provides the capability to measure these properties under any STM operating condition in hydrogen. One complete radial scan of these parameters has been completed, and the results are discussed in this report. DOE

N86-29685# Department of Energy, Washington, D. C. Office of Fusion Energy.
INTERNATIONAL PROGRAM ACTIVITIES IN MAGNETIC FUSION ENERGY
Mar. 1986 20 p
(DE86-005797; DOE/ER-0258) Avail: NTIS HC A02/MF A01

The following areas of our international activities in magnetic fusion are briefly described: (1) policy; (2) background; (3) strategy; (4) strategic considerations and concerns; (5) domestic program implications, and (6) implementation. The current US activities are reviewed. Some of our present program needs are outlined. DOE

N86-29686# Harvard Univ., Cambridge, Mass. Div. of Applied Sciences.
TIME-RESOLVED SPECTROSCOPY OF PLASMA RESONANCES IN HIGHLY EXCITED SILICON AND GERMANIUM
C. Y. Huang, A. M. Malvezzi, N. Bloembergen, and H. Kurz 1985 13 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985 Prepared in cooperation with Los Alamos National Lab., N. Mex. and Technische Hochschule, Aachen, West Germany
(Contract W-7405-eng-36)
(DE86-006035; LA-UR-86-340; CONF-851217-43) Avail: NTIS HC A02/MF A01

The dynamics of the electron-hole plasma in silicon and germanium samples irradiated by 20 ps. 532 nm laser pulses has been investigated in the near infrared by time-resolved picosecond optical spectroscopy. The experimental reflectivities and transmission are compared with the predictions of the thermal model for degenerate carrier distributions through the Drude formalism. Above a certain fluence, a significant deviation between measured and calculated values indicates a strong increase of the recombination rate as soon as the plasma resonances become comparable with the band gaps. These new plasmon-aided recombination channels are particularly pronounced in germanium. DOE

N86-29687# Los Alamos National Lab., N. Mex.
EXCIMER LASER DEVELOPMENT FOR FUSION

D. Giovanielli 1985 8 p Presented at the 17th European Conference on Laser Interaction with Matter, Rome, Italy, 18 Nov. 1985
(Contract W-7405-eng-36)
(DE86-007385; LA-UR-86-503; CONF-851128-1) Avail: NTIS HC A02/MF A01

The future utility of inertial confinement fusion (ICF) requires a new driver. Successful experiments coupling laser energy to targets and our understanding of fuel capsule behavior strongly suggest that a laboratory thermonuclear source is attainable and power production may be considered if a suitable driver with high efficiency, high repetition rate, and most importantly, low capital cost, can be identified. No adequate driver exists today. However, the krypton fluoride laser holds great promise. By the end of this decade, driver development can be brought to the point that a technically justifiable choice can be made for the future direction of ICF. DOE

N86-29688# Wisconsin Univ., Madison. Dept. of Electrical and Computer Engineering.
STELLARATOR THEORY AND STABILITY
W. N. G. Hitchon 1986 38 p
(Contract DE-FG02-85ER-53201)
(DE86-008054; DOE/ER-53201/1) Avail: NTIS HC A03/MF A01

This report summarizes our work in the past year on stellarator transport theory and stability. We have developed two methods of calculating diffusion rates due to ripple transport: a hybrid bounce-averaged/guiding-center Monte Carlo code, and a numerical method of solving the bounce-averaged Fokker-Planck equation. We have modified a one-dimensional transport code to describe the Wisconsin stellarator experiments and applied it to interpret experimental results, and we have studied stability in stellarators by writing a computer code which solves the linearized double-adiabatic equations as an initial value problem. DOE

N86-29689# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Fisica dello Spazio Interplanetario.
OBLIQUE PROPAGATION OF NONLINEAR MAGNETOSONIC WAVES IN SPACE PLASMAS
H. A. Shah and R. Bruno Sep. 1985 20 p Sponsored by ICTP, Trieste
(IFSI-85-11; ESA-86-97095) Avail: NTIS HC A02/MF A01

Obliquely (with respect to the ambient magnetic field) propagating nonlinear magnetosonic waves in a hot plasma with an arbitrary beta are considered. It is shown that two dimensional propagation for the fast and slow modes is governed by the Kadomtsev-Petiashvilli soliton equation. Explicit expressions for the physical quantities involved are obtained via the soliton solution. Application to the distant magnetotail, and other possible applications in astrophysical and space plasmas are discussed. ESA

N86-29690# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Fisica dello Spazio Interplanetario.
COMPOSITION AND PLASMA PROPERTIES OF THE PLASMA SHEET IN THE EARTH'S MAGNETOTAIL
S. Orsini, K. Altwegg, and H. Balsiger Oct. 1985 27 p Submitted for publication
(IFSI-85-12; ESA-86-97096) Avail: NTIS HC A03/MF A01

Plasma sheet data from the ISEE-1 Ion Composition Experiment between 10 Re and 22 Re were analyzed to compare plasma density and temperature of H(+) and He(++) as a function of magnetospheric substorm activity and satellite position. The origin of the plasma sheet population is investigated; the contribution of the solar wind component and of the ionospheric component is discussed. The temperatures of H(+) and He(++) are well correlated. It is shown that high He(++) relative abundances are observed at high distances from the Earth, irrespective of the activity level. The plasma sheet H(+) temperature depends on the distance from the Earth: higher temperatures are detected at lower Re; the relative change of the H(+) temperature with Re is shown to depend on the average value of the activity index. ESA

N86-29691# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Fisica dello Spazio Interplanetario.
MAGNETIC FIELD CONTROL SYSTEM FOR THE SIMPLEX IONOSPHERIC PLASMA SIMULATOR [SISTEMA DI CONTROLLO DEL CAMPO MAGNETICO PER IL SIMULATORE DI PLASMA IONOSFERICO SIMPLEX]
G. Vannaroni Jan. 1986 22 p In ITALIAN
(IFSI-86-2; ESA-86-97101) Avail: NTIS HC A02/MF A01

Magnetic field control of the Simplex project, which includes a plasma generator and a vacuum chamber 4 by 1.7 m, requiring three axis vectorial control is described. The system is implemented by orthogonal windings designed to produce on each axis a magnetic field of up to 3 Gs. The residual magnetic field within the 1 cu m experimental volume is 2.8 mGs. The controlled fields are produced using currents of up to 50 A. The geometrical details of the windings are given. ESA

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N86-29692*# National Aeronautics and Space Administration, Washington, D.C.
REVIEW OF METHODS FOR PREPARATION OF ZINC AND CADMIUM SULFIDE, SELENIDE AND TELLURIDE SINGLE CYRSTALS
Mieczyslaw Kucharczyk and Krystyna Zabludowska May 1986 28 p Transl. into ENGLISH from Matematy ka Fizyka, Chemia (Poland), no. 1, 1976 p 3-21 Transl. by Scientific Translation Service, Santa Barbara, Calif.
(Contract NASw-4004)
(NASA-TM-88426; NAS 1.15:88426) Avail: NTIS HC A03/MF A01

The growth method of (Zn,Cd)S, (Zn,Cd)Se, (Zn,Cd)Te single crystals is reviewed. It is suggested that the method of sublimation-condensation is the most suitable to the conditions and facilities available, and should be employed in the Department of Physics of Bislystok Polytechnic. Author

N86-29693# Colorado Research Development Corp., Fort Collins.
SEMICONDUCTING TRANSITION METAL SILICIDES FOR ELECTRO-OPTIC VSLI INTERCONNECTS Interim Report
John E. Mahan 27 Nov. 1985 7 p
(Contract N00014-85-C-0874)
(AD-A165911; IR-2) Avail: NTIS HC A02/MF A01 CSCL 20/12

Optical and electrical measurements of the chromium disilicide forbidden energy gap have been made. These activities are detailed. The samples used for this experiment were formed by sputtering chromium onto silicon (100) wafers which had been thermally oxidized and then coated with a polysilicon layer. Chromium disilicide layers were formed with annealing temperatures ranging from 500 to 1100C to investigate the effect of this fabrication parameter on the forbidden energy gap of the films. Some initial measurements of the optical transmittance and reflectance of the chromium silicide films are shown using films formed on bare silicon wafers. These data have been analyzed using a computer model of the silicide film-silicon substrate system. The manganese and iridium sputtering targets have not arrived from the vendor. The work on these materials will begin as soon as these targets are received. GRA

N86-29694# Colorado State Univ., Fort Collins.
COMPOUND SEMICONDUCTOR SURFACES AND INTERFACES Final Report
C. W. Wilmsen 1986 10 p
(Contract N00014-76-C-0387)
(AD-A165947) Avail: NTIS HC A02/MF A01 CSCL 20/12

All semiconductor devices and integrated circuits require dielectric layers for interconnect isolation, gate oxides, passivation,

etc. Thermally grown SiO2 is the primary dielectric film for silicon technology. This ONR contract investigated the chemistry and electrical properties of the interface between III-V compound semiconductors and electrical properties of grown and deposited oxides. When this study began, very little was known about these oxides or their interfaces. The results of the research supported by this contract has added substantially to the fundamental understanding of the oxide growth, properties and electronic structure. Much of the experimental work was obtained with surface analytical techniques and significant contributions were also made in this field. The original ONR contract began in October 1975 and initially concentrated on the grown oxides of InP and GaAs. This work evolved over the years to include the study of deposited insulator/InP interfaces and trapping at the interface. The ONR contract has supported the publication of 31 journal articles and book chapters and numerous conference presentations. GRA

N86-29695# San Diego State Univ., Calif.
QUATERNARY NARROW-BAND SEMICONDUCTORS (HgTe)X (InSb)1-x FOR FAR-INFRARED DETECTORS Annual Report, 1 Sep. 1984 - 31 Aug. 1985
Lev I. Berger 31 Aug. 1986 97 p
(Contract N00014-83-K-0588)
(AD-A166008) Avail: NTIS HC A05/MF A01 CSCL 17/5

This annual report includes a description of results from work on an investigation of the quaternary system (HgTe)x(InSb)1-x in accordance with Project N00014-83-K-0588 during the second year, from September 1, 1984 to August 31, 1985. In the course of this time period, the systems for Bridgman-stockbarger growth, hot-wall epitaxial growth, and isothermal epitaxial growth were designed, assembled, and tested. On the basis of the results of the testing stage, the temperature-pressure-time regimes for single-crystal and epitaxial layer growth were developed. Several single crystals of the solid solutions of HgTe in InSb with the HgTe contents up to 15 mole percent were grown and assessed. The report includes growth parameters for the bulk crystals with composition x = 0.05, 0.10, 0.12 and 0.15. These crystals cover the energy gap range from 0.10 to 0.14 eV or the cut-off wavelength range from 12.4 to 8.9 micron. GRA

N86-29696# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
MAGNETO-OPTIC STUDIES OF SEMICONDUCTOR STRUCTURES AT HYDROSTATIC PRESSURE AND LOW TEMPERATURE Ph.D. Thesis
Harro Ackermann Dec. 1985 145 p
(AD-A166419; AFIT/CI/NR-86-25D) Avail: NTIS HC A07/MF A01 CSCL 20/12

We developed an unique experimental system to perform optical investigations of semiconductor materials in environments generally beyond the capability of other techniques. Using the solid helium pressure generating method and a superconducting magnet, we performed laser induced luminescence studies on a variety of structures at low temperature (less than or equal to 4K), high hydrostatic pressure, and high magnetic field. A quartz fiber was utilized to provide an optical path to and from a sample subjected to values of the external parameters. The use of the fiber alleviated the need for pressure chamber windows and concern for the transmissivity of the pressure medium, and allowed investigations over a frequency range limited only by the optical properties of the fiber. GRA

N86-29697# Argonne National Lab., Ill. Materials Science and Technology Div.
NOVEL CHARACTERIZATION OF THIN FILM MULTILAYERED STRUCTURES; MICROCLEAVAGE TRANSMISSION ELECTRON MICROSCOPY
Yves Lepetre, Ivan K. Schuller, George Rasigni (Aix-Marseilles Univ., France), Rene Rivoira, Roger Philip, and Pierre Dhez (Paris-Sud Univ., Orsay, France) Jul. 1985 7 p Presented at SPIE's 29th Annual International Technical Symposium: Applications of Thin-Film Multilayered Structures to Figured X-ray Optics, San Diego, Calif., 18-23 Aug. 1985
(DE85-018373; CONF-850887-43) Avail: NTIS HC A02/MF A01

Microcleavage Transmission Electron Microscopy has been applied to the study of many properties of multilayered samples. The unique capabilities of this technique are illustrated to study long range perpendicular thickness drifts, lateral variations, roughness, substrate quality and island structures. Author

N86-29698# Lawrence Livermore National Lab., Calif.
MOLECULAR DYNAMICS STUDIES OF ENERGY TRANSFER PROCESSES IN CRYSTAL SYSTEMS Annual Summary Report
A. M. Karo and F. E. Walker Dec. 1985 9 p
(Contract W-7405-eng-48)
(DE86-004917; UCID-20620) Avail: NTIS HC A02/MF A01

During the preceding contract period, our molecular dynamics codes have been significantly extended to allow for a monitoring of local variables, such as energy as a function of time for any selected region, or for the entire ensemble of interacting particles. In this way we can observe the manner in which energy flows into and out of any particular unit, and, in the case of a polyatomic unit, the energy flux between different degrees of freedom. Further compacting of the flux data has been found desirable and is accomplished by computing the temporal Fourier transforms. This can be done for varying time intervals and the whole history reduced to a manageable number of figures. Thus, the frequency fingerprints for a given system can be presented before, during, and after shock front transit through the tagged system. For a one- or two-atom unit one can completely specify the state of the system by giving its center-of-mass energy, its rotational energy about the center of mass, and its vibrational energy. We have chosen to separate the total energy of any assembly into these constituents. The energy components are not constants of the motion, and even for a two-body system the vibrational and rotational motions are coupled by the Coriolis coupling which can be very strong. DOE

N86-29699# Oak Ridge National Lab., Tenn.
EFFECTIVE VIBRATION ISOLATION SYSTEM FOR PERFECT-CRYSTAL NEUTRON INTERFEROMETRY
J. Arthur 1985 7 p Presented at the Workshop on the Investigation of Fundamental Interactions With Cold Neutrons, Gaithersburg, Md., 14 Nov. 1985
(Contract DE-AC05-84OR-21400)
(DE86-005025; CONF-8511137-3) Avail: NTIS HC A02/MF A01

Perfect-crystal neutron interferometers are subject to degradation of their performance caused by vibrational accelerations. It is shown that the most seriously offending accelerations are rotational. An effective and simple vibration isolation system that was developed at the MIT Neutron Diffraction Laboratory is described. DOE

N86-29700# Lawrence Livermore National Lab., Calif.
SEMICONDUCTOR DEVICE MODELING WITH BURN42: A ONE-DIMENSIONAL CODE FOR MODELING SOLID STATE DEVICES
W. J. Orvis and J. H. Yee Aug. 1985 28 p
(Contract W-7405-eng-48)
(DE86-005101; UCID-20602) Avail: NTIS HC A03/MF A01

Version 42 of the BURN series of computer codes, models a one-dimensional semiconductor device in a simple external circuit. This code will model a two-pole semiconductor device made from a single material (currently assumed to be silicon) with an arbitrary doping profile. The code handles high and low applied voltages, high and low temperatures, and includes electrical generation of heat in the modeled device. The code has been used to model semiconductor diode operation and failure during high voltage transients, similar to those expected to be generated by an electromagnetic pulse (EMP) or a beam of intense microwaves. The results agree well with experimental data and show some unexpected details in the pulse failure threshold curve for a small signal diode. DOE

N86-29701# Sandia National Labs., Albuquerque, N. Mex.
MONTE CARLO SIMULATION OF GROWTH OF CRYSTALLINE

AND AMORPHOUS SILICON
B. W. Dodson and P. A. Taylor 1985 6 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985
(Contract DE-AC04-76DP-00789)
(DE86-005635; SAND-85-1402C; CONF-851217-38) Avail: NTIS HC A02/MF A01

The authors have previously introduced a method, based on Monte Carlo techniques, for simulation of crystal growth processes in a continuous space. We have applied the method, initially used to simulate growth of two-dimensional Lennard-Jones systems, to treat growth of silicon in three dimensions. The interaction model for silicon is taken to be the recently introduced Stillinger-Weber (S-W) potential, which is a two- and three-body classical potential. Although the early stages of growth seem to be well modelled by the S-W potential, growth of even a single monolayer of epitaxial (111) silicon does not seem to be possible. Modifications to the S-W potential were considered, and found to be unacceptable physically. More accurate treatment of non-ideal atomic configuration energies is necessary to arrive at physically realistic growth simulations. DOE

N86-29702# Brookhaven National Lab., Upton, N. Y.
ELECTRON BAND THEORY PREDICTIONS AND THE CONSTRUCTION OF PHASE DIAGRAMS
R. E. Watson, L. H. Bennett, J. W. Davenport, and M. Weinert 1985 14 p Presented at the TMS/AIME Fall Meeting, Toronto, Ontario, 13 Oct. 1985 Prepared in cooperation with National Bureau of Standards, Washington, D.C.
(Contract DE-AC02-76CH-00016)
(DE86-005811; BNL-37534; CONF-8510168-8) Avail: NTIS HC A02/MF A01

The priori theory of metals is yielding energy results which are relevant to the construction of phase diagrams - to the solution phases as well as to line compounds. There is a wide range in the rigor of the calculations currently being done and this is discussed. Calculations for the structural stabilities (fcc vs bcc vs hcp) of the elemental metals, quantities which are employed in the constructs of the terminal phases, are reviewed and shown to be inconsistent with the values currently employed in such constructs (also see Miodownik elsewhere in this volume). Finally, as an example, the calculated heats of formation are compared with experiment for PtHf, IrTa and OsW, three compounds with the same electron to atom ratio but different bonding properties. DOE

N86-29703# Pacific Northwest Lab., Richland, Wash.
RAMAN STUDIES OF PHASE TRANSFORMATIONS IN PULSE LASER IRRADIATED DIELECTRIC FILMS
G. J. Exarhos Oct. 1985 19 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985
(Contract DE-AC06-76RL-01830)
(DE86-004881; PNL-SA-13528; CONF-851217-45) Avail: NTIS HC A02/MF A01

Sputter deposited TiO2 and ZrO2 films on silica have been characterized. Multilayer stacks, useful for high energy laser mirror applications, have also been studied using probe wavelengths, which take advantage of the coating optical properties to enhance the Raman signal through interference effects. Spatially and time-resolved Raman spectra from these oxidic coatings have been acquired immediately following irradiation at 1.064, .532, or .355 microns and at longer times. Transient measurements are designed to follow surface transformation/relaxation phenomena; measurements at longer times characterize the equilibrium damage state. Irradiated anatase coatings exhibit vibrational features that irreversibly shift to higher frequencies, suggesting an increase in localized stress. Catastrophic damage is manifested by the appearance of a higher density rutile phase. Rutile coatings examined after irradiation show only intensity changes, although marked changes in the polarized Raman scattering are apparent for grain-oriented coatings, suggesting that recrystallization has occurred. Amorphous coatings were found to rapidly crystallize under high-pulse energy irradiation. Results of these studies are compared with equilibrium Raman measurements of thermally-induced transformations in these materials. DOE

N86-29704# Lawrence Livermore National Lab., Calif.
DRIVING FORCE FOR EXAGGERATED GRAIN GROWTH
A. W. Searcy Oct. 1985 11 p Presented at the 38th American Ceramic Society Pacific Coast Regional Meeting, Irvine, Calif., 28 Oct. 1985
(Contract DE-AC03-76SF-00098)
(DE86-006060; LBL-20524; CONF-8510111-1) Avail: NTIS HC A02/MF A01

The driving force for exaggerated grain growth is derived from a new surface thermodynamic theory which reconciles the kinetics of equilibrium to the thermodynamics of equilibrium between subparts of a particle with anisotropic surface energies. Exaggerated growth is driven by the reduction in dislocation and grain boundary free energies produced when a larger grain sweeps out a volume element formerly occupied by small grains. Whether the advancing boundary is planar, concave, or convex depends on the relative rates of ledge nucleation and growth, on the growth direction, and on whether growth occurs at screw dislocations. The model is compared to observations and additional tests are suggested. DOE

N86-29705# Argonne National Lab., Ill.
CRYSTALLINE-TO-AMORPHOUS PHASE TRANSITION IN IRRADIATED SILICON
D. N. Seidman (Northwestern Univ., Evanston, Ill.), R. S. Averback, P. R. Okamoto, and A. C. Baily Jan. 1986 9 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985
(Contract W-31-109-eng-38)
(DE86-006170; CONF-851217-40) Avail: NTIS HC A02/MF A01

The amorphous(a)-to-crystalline (c) phase transition has been studied in electron(e(-)) and/or ion irradiated silicon (Si). The irradiations were performed in situ in the Argonne High Voltage Microscope-Tandem Facility. The irradiation of Si, at <10 K, with 1-MeV e(-) to a fluence of 14 dpa failed to induce the c-to-a transition. Whereas an irradiation, at <10 K, with 1.0 or 1.5-MeV Kr+ ions induced the c-to-a transition by a fluence of approx.0. 37 dpa. Alternatively a dual irradiation, at 10 K, with 1.0-MeV e(-) and 1.0 or 1.5-MeV Kr+ to a Kr+ fluence of 1.5 dpa where the ratio of the displacement rates for e(-) to ions was approx.0.5 - resulted in the Si specimen retaining a degree of crystallinity. These results are discussed in terms of the degree of dispersion of point defects in the primary state of damage and the mobilities of point defects. DOE

N86-29706# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.
POLYCRYSTALLINE THIN-FILMS Annual Report
K. Zweibel and R. Mitchell Feb. 1986 32 p
(Contract DE-AC02-83CH-10093)
(DE86-004426; SERI/PR-211-2874) Avail: NTIS HC A03/MF A01

This annual report summarizes the status, accomplishments, and projected future research directions of the Polycrystalline Thin Film Task in the Photovoltaic Program Branch of the Solar Energy Research Institute's Solar Electric Research Division. Major subcontracted work in this area has concentrated on development of CuInSe2 and CdTe technologies. During FY 1985, major progress was achieved by subcontractors in: (1) developing a new, low-cost method of fabricating CuInSe2, and (2) improving the efficiency of CuInSe2 devices by about 10% (relative). The report also lists research planned to meet the Department of Energy's goals in these technologies. DOE

N86-29707# Naval Research Lab., Washington, D. C.
SPECTROSCOPIC STUDIES OF HYDROGENATED AMORPHOUS SILICON Annual Report, 15 Mar. 1984 - 15 Mar. 1985
S. G. Bishop and W. E. Carlos Feb. 1986 18 p
(Contract DE-AC02-83CH-10093)
(DE86-004427; SERI/STR-211-2896) Avail: NTIS HC A02/MF A01

Nuclear magnetic resonance (NMR), electron spin resonance (ESR), and photoluminescence (PL) spectroscopies have been used to study amorphous silicon films prepared by SERI subcontractors. NMR measurements show that the bonding of hydrogen in material propared by chemical vapor deposition (CVD) is similar to that in a-Si:H prepared using glow discharge. ESR and PL have been used to depth profile defects in CVD prepared films. These measurements indicate a concentration of defects in the top 5000 A. Light-induced effects in CVD-prepared films and dopants in microcrystalline Si:H have also been studied using ESR. DOE

N86-29708# State Univ. of New York, Stony Brook. Dept. of Physics.
CALCULATIONS OF RESISTIVITY AND SUPERCONDUCTING T/SUB c/ IN TRANSITION METALS
P. B. Allen, T. P. Beaulac, F. S. Khan, W. H. Butler, F. J. Pinski, and J. C. Swihart 1985 13 p Presented at the Materials Research Society Meeting, Boston, Mass., 2 Dec. 1985 Prepared in cooperation with Oak Ridge National Lab., Tenn.
(Contract DE-AC05-84OR-21400)
(DE86-007869; CONF-851217-58) Avail: NTIS HC A02/MF A01

A survey is given of various electron-phonon effects which have been calculated for the metals Nb, Mo, Ta, Pd, and Cu. These effects include the mass enhancement lambda, superconducting T sub c, electrical and thermal resistivity, Hall coefficient, magnetoresistance, and the successfully tested predictions of linewidths (GAMMA)O of phonons. The calculations use local density approximations (LDA) energy bands, experimental phonons, and the rigid muffin tin (RMT) approximation. Mesh size noise is less than 1% and the Bloch-Boltzmann integral equation has been solved to unprecedented accuracy. DOE

N86-29709# Argonne National Lab., Ill.
CRYSTAL DIFFRACTION LENS AS A LONG RANGE GAMMA RAY SENSOR
R. K. Smither 1985 31 p Presented at the Workshop on Interactive Discrimination, Cambridge, Mass., 18 Nov. 1985
(Contract W-31-109-eng-38)
(DE86-005562; CONF-8511162-1) Avail: NTIS HC A03/MF A01

A need has been identified for a detection system that could detect the presence of nuclear warhead in a missile or a satellite. The interrogation of a missile would most likely be active considering the short time available and the long distances involved (100 km to 1000 km). Although some sort of active interrogation process could be considered for the satellite case in peacetime, it would be highly desirable if the system were passive. It would also be highly desirable if the system could operate at relatively long distances from the satellite (1 km to 100 km). This proposal uses new technology developed at the Argonne National laboratory to develop a detector system that appears to have the needed sensitivity, directionality, and selective response function to achieve these goals. The system will use crystal diffraction lenses to detect the presence of characteristic x-rays and gamma-rays emitted from the fissile material and surrounding support structures. The angular resolution of the lens is sufficient to construct an image of the fissile material in the satellite assembly and detect the rpesence of more than one concentration of fissile material if there are multiple warheads on board if the lens is within 10 km of the object. A typical crystal lens would be 2 to 4 meters in diameter and consist of many thousands of small crystals mounted in circular arrays. DOE

N86-29710# Florida State Univ., Tallahassee.
He-ATOM SURFACE SCATTERING APPARATUS FOR STUDIES OF CRYSTALLINE SURFACE DYNAMICS Progress Report, 1 May 1985 - 30 Apr. 1986
1986 6 p
(Contract DE-FG05-85ER-45208)
(DE86-006794; DOE/ER-45208/1) Avail: NTIS HC A02/MF A01

The primary goal of this grant is the construction of a state-of-the-art He atom-crystal surface scattering apparatus which will be capable of measuring both elastic and inelastic scattering of He atoms from crystal surfaces of metals, semiconductors and insulators. First, the apparatus will be constructed and characterized, after which a program of studies on the surface dynamics of a variety of crystal surfaces will be started. DOE

N86-29711# Michigan Technological Univ., Houghton. Dept. of Physics.
THEORY OF DEFECTS IN NON-METALLIC SOLIDS Progress Report, 1 Aug. 1985 - 31 Dec. 1985
A. B. Kunz Feb. 1986 9 p
(Contract DE-FG02-85ER-45224)
(DE86-007660; DOE/ER-45224/1) Avail: NTIS HC A02/MF A01

A general method based upon ab initio quantum mechanical modeling of the region of a solid in the vicinity of a defect or impurity and upon the use of classical modeling of more remote regions in a self-consistent way is being undertaken. The initial progress has been in defining the scope of the model, validation of the several concepts, generation of some necessary theoretical formalism, and finally in an initial study of the excitonic spectra of several alkali iodides. This latter study is significant in several ways. It establishes: the size of cluster needed for such studies; the utility of norm-conserving core replacing pseudo potentials; and the need of treating spin-orbit and multiple structure in a proper way for localized excitation. DOE

N86-28980# Joint Publications Research Service, Arlington, Va.
PHILIPS DEVELOPS A NEW KIND OF SEMICONDUCTOR IMAGE SENSOR
In its West Europe report: Science and Technology (JPSR-WST-85-021) 12 Jul. 1985 2 p Transl. into ENGLISH from Frankfurter Zeitung/Blick Durch die Wirtschaft (Frankfurt-Main, West Germany), 8 May 1985 p 5 (For primary document see N86-28978 20-16)
Avail: NTIS HC A04/MF A01

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N86-29712# Lawrence Livermore National Lab., Calif.
SOME OF DUHEM'S CONTRIBUTIONS TO THERMODYNAMICS
D. G. Miller Oct. 1985 9 p Presented at the History of Science Society Annual Meeting, Bloomington, Ind., 31 Oct. 1985
(Contract W-7405-eng-48)
(DE86-002138; UCRL-93525; CONF-8510189-1) Avail: NTIS HC A02/MF A01

A number of Duhem's contributions to thermodynamics are presented. These include the systematic use of the thermodynamic potential and chemical potentials to obtain useful results, the Gibbs-Duhem and Duhem-Margules equations, the first rigorous definition of reversible processes, an excellent axiomatization of the First Law, and generalization of the Phase Rule to include masses. DOE

N86-29713# Technische Hogeschool Twente, Enschede (Netherlands). Dept. of Applied Mathematics.
THE HARMONIC MAP AND KILLING FIELDS FOR SELF-DUAL SU(3) YANG-MILLS EQUATIONS
Paul Kersten and Ruud Martini Jun. 1984 89 p
(Memo-443; ESA-86-97364) Avail: NTIS HC A05/MF A01

Using symbolic computations, the unique metric in the manifold of fields, required to describe self-dual SU(3) Yang-Mills equations by a harmonic map between Riemannian manifolds, is determined. The complete Lie-algebra of Killing fields for this metric is established. ESA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N86-29714# Committee on Science and Technology (U. S. House).
SPACE COMMERCIALIZATION: 1985
1986 826 p Hearings before the Subcommittee on Space Science and Applications of the Committee on Science and Technology, 99th Congress, 1st Session, no. 90, 18-20 Jun., 10-11 Sep., 30-31 Oct. 1985
(GPO-54-584) Avail: Subcommittee on Space Science and Applications

The prospects for emerging space-related industries and the potential markets were examined as a baseline for exploring the financial and commercialization issues confronting commercial space ventures and the role of Government. B.G.

N86-29715# Department of Defense, Washington, D. C.
DEFENSE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR) ABSTRACTS OF PHASE 1 AWARDS, 1984
16 Apr. 1985 224 p
(AD-A165856) Avail: NTIS HC A10/MF A01 CSCL 15/5

This document is a bibliography of technical abstracts which describe the nature of the funded FY 1984 Phase 1 Small Business Innovation Research (SBIR) projects. Proprietary information is not provided in these abstracts. Therefore, technical details may be missing. For this reason, the report supplies the names of individuals in the small business firms who may be contacted should more information be needed on a specific project. Each abstract lists the company, responsible partly, title, service or agency, and gives award and dollar amount. GRA

N86-29716# Massachusetts Inst. of Tech., Cambridge.
PLANNING FOR CONJUNCTIVE GOALS M.S. Thesis. Technical Report, 1983 - 1985
David Chapman Nov. 1985 64 p Sponsored in part by IBM
(Contract N00014-80-C-0505; Grants NSF MCS-79-12179; NSF MCS-81-17633)
(AD-A165883; AI-TR-802) Avail: NTIS HC A04/MF A01 CSCL 05/1

The problem of achieving conjunctive goals has been central to domain-independent planning research; the nonlinear constraint-posting approach has been most successful. Previous planners of this type have been complicated, heuristic, and ill-defined. I have combined and distilled the state of the art into a simple, precise, implemented algorithm (TWEAK) which I have proved correct and complete. I analyze previous work on domain-independent conjunctive planning; in retrospect it becomes clear that all conjunctive planners, linear and nonlinear, work the same way. The efficiency of these planners depends on the traditional add/delete-list representation for actions, which drastically limits their usefulness. I present theorems that suggest that efficient general purpose planning with more expressive action representations is impossible, and suggest ways to avoid this problem. GRA

N86-29717# Kernforschungszentrum, Karlsruhe (West Germany).
STRATEGIES FOR IMPLEMENTING CAD. APPLICATION OF CAD AS A PROCESS OF PERSONNEL AND ORGANIZATIONAL DEVELOPMENT. PREPARATION AND REALIZATION OF THE IMPLEMENTATION PROCESS, VOLUME 1
W. Schaffitzel, U. Sellmer, K. Schlagenhauf, R. Kupferschmitt, and B. Schmid Aug. 1985 270 p In GERMAN; ENGLISH summary
(Contract BMFT-F11-050-KA-IAO/11)
(KfK-PFT-110-Vol-1; ESA-86-96906) Avail: NTIS HC A12/MF A01

Guidelines for the implementation of integrated CAD/CAM systems in industry and experience with industrial partners are presented. A project to analyze the experience of innovative companies and to stimulate the CAD/CAM applications in industry was developed. ESA

N86-29718# Kernforschungszentrum, Karlsruhe (West Germany).
STRATEGIES FOR IMPLEMENTING CAD. APPLICATION OF CAD AS A PROCESS OF PERSONNEL AND ORGANIZATIONAL DEVELOPMENT. PREPARATION AND REALIZATION OF THE IMPLEMENTATION PROCESS, VOLUME 2
W. Schaffitzel, U. Sellmer, K. Schlagenhauf, R. Kupferschmitt, B. Schmid, and V. Vassilakopoulos Aug. 1985 226 p In GERMAN; ENGLISH summary
(Contract BMFT-F11-050-KA-IAO/11)
(KfK-PFT-111-Vol-2; ESA-86-96907) Avail: NTIS HC A11/MF A01

A complete concept for CAD education is presented with a view to integration of CAD/CAM systems in industry. The concept is directed towards experts and politicians. It is based on investigations of CAD education activities, on advice of commissions, and on inquiries made in industries, universities, and institutes of technology. A market analysis among CAD tenderers is explained. An example of user-oriented tailoring of education material (teachware) is given. ESA

N86-29719# Farrell Lines, Inc., N.Y.
MICROCOMPUTER-BASED COST ANALYSIS SYSTEM. EXECUTIVE SUMMARY Report, Oct. 1982 - Jan. 1985
L. Smith and N. F. Kondas Nov. 1985 11 p Sponsored by Maritime Administration Prepared in cooperation with Temple, Barker and Sloane, Inc., Lexington, Mass.
(PB86-181930; MA-RD-770-85040) Avail: NTIS HC A02/MF A01; also available in set of 3 reports HC E99 as PB86-181922 CSCL 05A

This is the final report on a project to develop an overall corporate cost accounting and planning system having four main objectives: to create productivity standards and cost accountability at the local level by implementing an automated weekly cost reporting system; and to capture detailed intermodal transportation cost and summarize cost and recovery to help tariff making and cost control; to use the automated cost reporting system data base to improve accuracy and timeliness of preparation of corporate financial statements; and to create matrices of intermodal through unit costs for flexible freight solicitation decision making. Author

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information storage and retrieval technology; micrography; and library science.

For computer documentation see *61 Computer Programming and Software.*

N86-29720* National Aeronautics and Space Administration, Washington, D.C.
NASA THESAURUS SUPPLEMENT: A 4-PART CUMULATIVE SUPPLEMENT TO THE 1985 EDITION OF THE NASA THESAURUS
May 1986 155 p
(NASA-SP-7053(Supp-1); NAS 1.21:7053(Supp-1)) Avail: NTIS HC A08 CSCL 05B

The four part cumulative NASA Thesaurus Supplement to the 1985 edition ofthe NASA Thesaurus includes Part 1, Hierarchical Listing, Part 2, Access Vocabulary, Part 3, NASA Thesaurus Definitions, and Part 4, Changes. The semiannual supplement gives complete hierarchies for new terms. Author

N86-29721# University of Southern California, Marina del Rey. Information Sciences Inst.
DESIGN OF A MASTER LEXICON
Susanna Cumming Feb. 1986 28 p
(Contract MDA903-81-C-0335)
(AD-A165999; ISI/RR-85-163) Avail: NTIS HC A03/MF A01 CSCL 05/7

This document describes the design for a 'Master Lexicon' which is intended to serve all the lexical needs of the two grammars (RUS, an ATN parser, and Nigel, a systemic production grammar) of the JANUS natural language project. Each grammar had previously been using its own lexicon, and these two lexicons were significantly different, both in terms of content and in terms of design. The Master Lexicon incorporates features of each of the previous lexicons, significantly Nigel's feature hierarchy and RUS's treatment of morphology and cross-indexing; plus it includes several novel features, most notably a new lexical acquisition interface which allows the non-specialist user to add lexical items. Nigel is able to access the Master Lexicon directly, while a set of translation rules (given in the appendix) transform ML lexical entries to lexical entries of the style used by RUS. igel, Penman, RUS, Syntax, Systemic Linguistics, Text generation, Vocabulary, Word acquisition, Wordclass hierarchy, Wordclasses. GRA

N86-29722# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.
A STRUCTURAL OPTIMIZATION METHOD FOR INFORMATION RESOURCE MANAGEMENT Ph.D. Thesis
Richard E. Peschke Dec. 1985 234 p
(AD-A166420; AFIT/CI/NR-86-12D) Avail: NTIS HC A11/MF A01 CSCL 05/1

The mainstays of management activity and managers have traditionally been the organizational resources of manpower, money, material and machines. The inclusion of these support resources early in the acquisition process has had a significant impact on the support of major systems. However, traditional management of these resources alone, is no longer adequate to insure the successful accomplishment of organizational goals and objectives. Organizational planning must include information and information systems in the early stages of the development process if system activities are to continue to insure mission support. The application of a multiattribute design methodology is a practical way to describe alternative versions of a proposed information system. This research makes a contribution to the Information Resource Management concept by developing a structured optimization methodology that will allow the designer-planner to efficiently guide the information system design process toward consistently meeting the IRM requirements of the organization. Additionally, this research devel ops a formal criterion function modeling procedure that evaluates alternative candidate systems through explicit analysis of both qualitative and quantitative criteria. GRA

N86-29723# Lawrence Livermore National Lab., Calif.
SPATIAL DATA HANDLING CAPABILITIES IN EMERGENCY RESPONSE
H. Walker Dec. 1985 14 p Presented at the Geographic Information Systems in the Government Workshop, Springfield, Va., 10 Dec. 1985
(Contract W-7405-eng-48)
(DE86-005089; UCRL-93416; CONF-851252-2) Avail: NTIS HC A02/MF A01

The ability of organizations to respond effectively to emergencies requires the utilization of many types of data. For the Atmospheric Release Advisory Capability (ARAC), an operational system at the Lawrence Livermore National Laboratory which provides assessments of the environmental consequences of an accidental release of radioactive material, much of the necessary data are geographical in nature. A system has been created that integrates numerical models, data acquisition systems, data analysis techniques, and professional staff. The ARAC system relies on two types of spatial data. First, digital terrain data is used as input to atmospheric models and, when presented in a graphical form, also serve to orient ARAC staff in unfamiliar areas. Secondly, geographic features (roads, rivers, political boundaries) are used as a base map to provide a reference frame for the graphical output from the ARAC models. A terrain system has been developed that provides terrain data at 500 meter resolution around any location in the conterminous United States within five minutes after an emergency notification. The ability to quickly create an appropriate base map using paper map products and digital map data also exists. Interactive computer graphics is an essential part of both the terrain and base mapping systems. DOE

N86-29724# Pacific Northwest Lab., Richland, Wash.
ASSURANCE PROGRAM FOR REMEDIAL ACTION (APRA) MICROCOMPUTER-OPERATED BIBLIOGRAPHY MANAGEMENT SYSTEM
R. D. Stenner, D. K. Washburn, and D. H. Denham Oct. 1985 10 p Presented at the 19th Midyear Topical Symposium on Health Physics Considerations in Decontamination and Decommissioning, Knoxville, Tenn., 2 Feb. 1986
(Contract DE-AC06-76RL-01830)
(DE86-007739; PNL-SA-13520; CONF-860203-15) Avail: NTIS HC A02/MF A01

Pacific Northwest Laboratory (PNL) provided technical assistance to the Office of Operational Safety (OOS) in developing their Assurance Program for Remedial Action (APRA). The APRA Bibliography Management System (BMS), a microcomputer-operated system designed to file, locate and retrieve project-specific bibliographic data, was developed to manage the documentation associated with APRA. The BMS uses APRABASE, a PNL-developed computer program written in dBASE II language, which is designed to operate using the commercially available dBASE II database software. The paper describes the APRABASE computer program, its associated subprograms, and the dBASE II APRA file. Although the BMS was designed to manage APRA-associated documents, it could be easily adapted for use in handling bibliographic data associated with any project. DOE

N86-29725# Societe Nationale Industrielle Aerospatiale, Paris (France).
RESEARCH IN THE FRAMEWORK OF A TERMINOLOGY NETWORK IN THE FIELD OF SPACE TECHNOLOGY [TRAVAIL DANS LE CADRE D'UN RESEAU DE TERMINOLOGIE EN MATIERE DE TECHNOLOGIE DE L'ESPACE]
Meyer Boudjedid 1986 9 p In FRENCH Presented at 2nd Infoterm Symposium
(SNIAS-861-550-101; ESA-86-97178) Avail: NTIS HC A02/MF A01

The network implemented by a leading aerospace company is described. It is based on a terminological and linguistic coordination extended to national and international levels, a terminological data bank, and a dictionary publishing center. The integration of these activities in an industrial organization is explained. The role played by automatic translation systems is discussed. ESA

N86-29726# Office of the Under Secretary of Defense for Policy, Washington, D.C.
CONTROL OF UNCLASSIFIED TECHNICAL DATA WITH MILITARY OR SPACE APPLICATION
D. Whitman May 1985 37 p
(PB86-183282; DOD-5230.25-PH) Avail: NTIS HC A03/MF A01 CSCL 05B

A report on Control of Unclassified Technical Data with Military or Space Application includes the following: Introduction, Background, Public Law 98-94, Defense implementation, Overall effect of the system. GRA

N86-29727# Touche, Ross and Co., Washington, D.C.
CORPORATE DATA NETWORK (CDN) DATA REQUIREMENTS TASK: PRELIMINARY STRATEGIC DATA PLAN
Nov. 1985 163 p
(Contract NRC-FIN-D1225)
(TI86-900472; NUREG/CR-4322-Vol-4) Avail: NTIS HC A08/MF A01

Background of the data requirement tasks; objective of the

strategic data plan; overview of the Corportation Data Network (CDN) and the logical data bases in the CDN; approach to plan development; evaluation criteria and methodology; qualitative factors which potentially affect developing priorities; development strategy; and schedule and budget estimates are summarized.
Author

N86-29728# Joint Publications Research Service, Arlington, Va.
USSR REPORT: SCIENCE AND TECHNOLOGY POLICY
19 May 1986 90 p Transl. into ENGLISH from various Russian articles
(JPRS-UST-86-014) Avail: NTIS HC A05/MF A01

Science and technology topics addressed incude: organization, planning, and coordination; facilities and manpower; training and eductation; automation and information policy; patents and inventions; conferences and expositions; awards and prizes; and international relations. For individual titles, see N86-29729 through N86-29730.

N86-29729# Joint Publications Research Service, Arlington, Va.
KAZAKH SCIENTIFIC, TECHNICAL INFORMATION ORGANS
T. Tursunbayev and M. Goldman *In its* USSR Report: Science and Technology Policy (JPRS-UST-86-014) 19 May 1986 p 39-44 Transl. into ENGLISH from Narodnoye Khozyaystvo Kazakhstana (Alma-Ata, USSR), no. 12, Dec. 1985 p 26-28 (For primary document see N86-29728 20-82)
Avail: NTIS HC A05/MF A01

The information support of scientific and technical progress is an indispensable condition of the development of the economy in the direction of its utmost intensification. The republic scientific and technical information system (RSNTI) is a part of the statewide scientific and technical information system. The tasks of the information support ad tracking of both comprehensive goal and other programs of the national economy were assigned to the structural subdivisions of this system. The level of the information service of the republic makes it possible to offer the users of scientific and technical information more than 20 forms and methods of specific services. At present 25,000 enterprises and organizations are using the service. The service to the users was automated and was significantly improved. The improvements are discussed along with their impacts on the information system. B.G.

N86-29730# Joint Publications Research Service, Arlington, Va.
PROBLEMS IN PUBLICATION OF SCIENTIFIC, TECHNICAL LITERATURE
M. Razmakhnin, ed. *In its* USSR Report: Science and Technology Policy (JPRS-UST-86-014) 19 May 1986 p 45-48 Transl. into ENGLISH from Knizhnoye Obozreniye (Moscow, USSR), no. 47, 22 Nov. 1985 p 6 (For primary document see N86-29728 20-82)
Avail: NTIS HC A05/MF A01

The impact of lack of computerized equipment in the printing industry is discussed, especially the impact on availability of technical publications. Suggestions to speed up the process are discussed. B.G.

N86-29294*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CENTRAL ON-LINE DATA DIRECTORY
James Thieman *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 3 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29295*# Pennsylvania State Univ., University Park. Dept. of Meteorology.
UNIVERSITY PARTICIPATION VIA UNIDATA, PART 1
John Dutton *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 7 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29296*# University Corp. for Atmospheric Research, Boulder, Colo.
UNIVERSITY PARTICIPATION VIA UNIDATA, PART 2
David W. Fulker *In* NASA. Goddard Space Flight Center Proceedings of the Second Pilot Climate Data System Workshop 1986 3 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29297*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NETWORK ACCESS TO PCDS (SPAN, ESN, SESNET, ARPANET)
James Green *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 29 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

N86-29298*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
METHODS OF DOWNLOADING TO USER INSTITUTIONS
Lloyd Treinish *In its* Proceedings of the Second Pilot Climate Data System Workshop 1986 10 p (For primary document see N86-29282 20-42)
Avail: NTIS HC A12/MF A01 CSCL 04B

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW AND POLITICAL SCIENCE

Includes space law; international law; international cooperation; and patent policy.

No abstracts in this category.

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N86-29731*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NASA/DOE AUTOMOTIVE STIRLING ENGINE PROJECT: OVERVIEW 1986 Final Report
Donald G. Beremand and Richard K. Shaltens 1986 21 p Prepared for presentation at the 21st Intersociety Energy Conversion Engineering Conference, San Diego, Calif., 25-29 Aug. 1986 (NASA-TM-87345; DOE/NASA-50112/66; E-3098; NAS 1.15:87345) Avail: NTIS HC A02/MF A01 CSCL 13F

The DOE/NASA Automotive Stirling Engine Project is reviewed and its technical progress and status are presented. Key technologies in materials, seals, and piston rings are progressing well. Seven first-generation engines, and modifications thereto, have accumulated over 15,000 hr of test time, including 1100hr of in-vehicle testing. Results indicate good progress toward the program goals. The first second-generation engine is now undergoing initial testing. It is expected that the program goal of a 30-percent improvement in fuel economy will be achieved in tests of a second-generation engine in a Celebrity vehicle. Author

N86-29732*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OVERVIEW OF NASA LEWIS RESEARCH CENTER FREE-PISTON STIRLING ENGINE TECHNOLOGY ACTIVITIES APPLICABLE TO SPACE POWER SYSTEMS Final Report
Jack G. Slaby 1986 13 p Proposed for presentation at the 4th Symposium on Space Nuclear Power Systems, Albuquerque, N. Mex., 12-16 Jan. 1987; sponsored by the Institute for Space Nuclear Power Studies
(Contract DE-AI05-82OR-1005)
(NASA-TM-88815; DOE/NASA-1005/10; E-3170; NAS 1.15:88815) Avail: NTIS HC A02/MF A01 CSCL 10B

Free piston Stirling technology is applicable for both solar and nuclear powered systems. As such, the Lewis Research Center serves as the project office to manage the newly initiated SP-100 Advanced Technology Program. This five year program provides the technology push for providing significant component and subsystem options for increased efficiency, reliability and survivability, and power output growth at reduced specific mass. One of the major elements of the program is the development of advanced power conversion concepts of which the Stirling cycle is a viable candidate. Under this program the research findings of the 25 kWe opposed piston Space Power Demonstrator Engine (SPDE) are presented. Included in the SPDE discussions are initial differences between predicted and experimental power outputs and power output influenced by variations in regenerators. Projections are made for future space power requirements over the next few decades. And a cursory comparison is presented showing the mass benefits that a Stirling system has over a Brayton system for the same peak temperature and output power. Author

N86-29733# Lawrence Livermore National Lab., Calif.
EE TECHNICAL REVIEW
Dec. 1985 79 p
(Contract W-7405-eng-48)
(DE86-005304; UCRL-50025-85-3) Avail: NTIS HC A05/MF A01

Brief summaries are given of electronics engineering work, including: laser engineering, engineering research, nuclear energy systems, engineering services, and field test systems. Individual papers are abstracted separately. DOE

N86-29734# Washington Consulting Group, Inc., Washington, D.C.
TECHNOLOGY TRANSFER PILOT STUDY Final Report
28 Jan. 1986 47 p Prepared in cooperation with Compass Corp., Inc., Milwaukie, OR.
(Contract DE-AC01-84DP-20143)
(DE86-005777; DOE/DP-20143/T1) Avail: NTIS HC A03/MF A01

Four specific technologies based on the Inertial Confinement Fusion Program were targeted for this initial study. The areas chosen were the CO2 laser, high pressure freon cleaning, video multiplexer, and plano-optics polishing. The study concluded that both Government and Industry are willing and anxious to promote and to reap the benefits of technology transfer. Recommendations were made in the areas of patent policy, documentation procedures in the transfer process, awareness training, and expansion of the scope of the study. DOE

N86-29735# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, Idaho.
ACCEPTANCE, VERIFICATION, AND PERFORMANCE TEST RESULTS FOR THE BEDFORD CF ELECTRIC VAN
H. W. Heiselmann Jan. 1986 193 p
(Contract DE-AC07-76ID-01570)
(DE86-007650; EGG-SE-7033) Avail: NTIS HC A09/MF A01

Acceptance, verification, and performance testing of a production Bedford CF Electric Van from Lucas Chloride Electric Vehicle Systems was performed for the US Department of Energy by EG and G Idaho, Inc. Battery characterization, as well as vehicle track and dynamometer tests, were performed. The track and dynamometer tests were performed in accordance with the Society of Automotive Engineers Electric Vehicle Test Procedures and the US Code of Federal Regulations, Title 10, Part 475. Results show the Bedford van is a sturdy, dependable vehicle with adequate accessories and good performance characteristics for its intended short-haul service use. City driving range is approximately 60 miles with an ac energy economy of approximately 0.9 kWh/mile. DOE

N86-29736# Brookhaven National Lab., Upton, N. Y.
TECHNOLOGY TRANSFER REPORT, FY 1985
1986 35 p
(Contract DE-AC02-76CH-00016)
(DE86-008394; BNL-37865) Avail: NTIS HC A03/MF A01

In FY 1985, the ORTA intensified its efforts in interacting with the private sector. Visits to the laboratory by industrial scientists searching for laboratory capabilities or inventions that would be of value to them increased. Several venture capital groups visited the laboratory and discussed mechanisms by which they might be able to implement the commercialization of laboratory technology. The ORTA has interacted with neighboring educational institutions and local government officials in the interest of establishing an incubator facility, a middle ground research facility, and a NASA sponsored space commercialization center. These activities will continue and a proposal has been submitted to DOE to initiate a mini-incubator at the laboratory to serve as an interim facility until a permanent facility is established. DOE

88 SPACE SCIENCES (GENERAL)

No abstracts in this category.

89 ASTRONOMY

Includes radio and gamma-ray astronomy; celestial mechanics; and astrometry.

N86-29737*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
HUBBLE SPACE TELESCOPE METEOROID-DEBRIS PROTECTION ANALYSIS
Jennifer Horn and Juan Maldonado Jun. 1986 38 p
(NASA-TM-86552; NAS 1.15:86552) Avail: NTIS HC A03/MF A01 CSCL 03A

A system level failure could occur if the Hubble Space Telescope's (ST) capability to operate as a facility on-orbit is critically reduced or when a significant reduction in the quality of science data is registered. Failure could occur if a meteoroid/debris impact damages a component of a major support subsystem or if a meteoroid/debris penetration causes straylight contamination in the light shield, forward shell, aft shroud, or through the aperture door. The ST was analyzed to find the probability of no critical penetration. This probability value was found to be 92.25% for a two-year service life. A straylight leakage repair technique was recommended for the aft shroud, the region found most likely to be critically penetrated. Fozar tape and multilayer insulation blankets are suggested as posible repair materials. M.G.

N86-29738*# Stanford Univ., Calif. Guidance and Control Lab.
SPACE INFRARED TELESCOPE POINTING CONTROL SYSTEM. INFRARED TELESCOPE TRACKING IN THE PRESENCE OF TARGET MOTION Final Report
J. David Powell and Julie Benson Schneider 6 Jun. 1986 112 p
(Grant NCA2-IR745-407)
(NASA-CR-177007; NAS 1.26:177007) Avail: NTIS HC A06/MF A01 CSCL 03A

The use of charge-coupled-devices, or CCD's, has been documented by a number of sources as an effective means of providing a measurement of spacecraft attitude with respect to

the stars. A method exists of defocussing and interpolation of the resulting shape of a star image over a small subsection of a large CCD array. This yields an increase in the accuracy of the device by better than an order of magnitude over the case when the star image is focussed upon a single CCD pixel. This research examines the effect that image motion has upon the overall precision of this star sensor when applied to an orbiting infrared observatory. While CCD's collect energy within the visible spectrum of light, the targets of scientific interest may well have no appreciable visible emissions. Image motion has the effect of smearing the image of the star in the direction of motion during a particular sampling interval. The presence of image motion is incorporated into a Kalman filter for the system, and it is shown that the addition of a gyro command term is adequate to compensate for the effect of image motion in the measurement. The updated gyro model is included in this analysis, but has natural frequencies faster than the projected star tracker sample rate for dim stars. The system state equations are reduced by modelling gyro drift as a white noise process. There exists a tradeoff in selected star tracker sample time between the CCD, which has improved noise characteristics as sample time increases, and the gyro, which will potentially drift further between long attitude updates. A sample time which minimizes pointing estimation error exists for the random drift gyro model as well as for a random walk gyro model. Author

N86-29739*# Helsinki Univ. (Finland).
A NOTE ON HAPKE'S BIDIRECTIONAL REFLECTANCE SPECTROSCOPY. PART 3: CORRECTION FOR MACROSCOPIC ROUGHNESS
Kari Lumme and Edward Bowell (Lowell Observatory, Flagstaff, Ariz.) 1986 13 p
(Grant NsG7-500)
(NASA-CR-176965; NAS 1.26:176965) Avail: NTIS HC A02/MF A01 CSCL 03A

The multiple-scattering theory of K. Lumme and E. Bowell (1981) was criticized by B. Hapke by stating, in particular, that energy is not conserved. It is shown that Hapke's treatment is, in this respect, inferior to that of Lumme and Bowell, and itself violates the principal concepts of radiative transfer theory. Hapke's additinal claim that, in Lumme and Bowell's work, the reflectance tends to zero at the limb is also refuted. Comment is made on the deduction of surface physical properties by modeling photometric observations. Author

N86-29740# Los Alamos National Lab., N. Mex.
LIGHT AND VELOCITY CURVES OF BUMP CEPHEIDS
A. N. Cox and C. R. Proffett 1985 4 p Presented at the 4th Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun, Santa Fe, N. Mex., 16 Oct.1985
(Contract W-7405-eng-36)
(DE86-003651; LA-UR-85-4110; CONF-8510265-3) Avail: NTIS HC A02/MF A01

Presented are light and velocity curves for eight hydrodynamic bump Cepheid models. All of the models were converged to the fundamental mode solution using a relaxation technique developed by Stellingwerf (1974). Use of this method assures that the time behavior repeats each period to better than one part in a thousand. The motivation for this work was to help Buchler, at the University of Florida, to develop his theory of modal interactions in pulsating stars. DOE

N86-29741# Los Alamos National Lab., N. Mex.
THEORETICAL INTERPRETATIONS OF ANOMALOUS CEPHEID PULSATIONS
A. N. Cox and C. R. Proffett 1985 4 p Presented at the 4th Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun, Santa Fe, N. Mex., 16 Oct. 1985
(Contract W-7405-eng-36)
(DE86-003652; LA-UR-85-4109; CONF-8510265-2) Avail: NTIS HC A02/MF A01

Anomalous Cepheids are variable stars found in metal poor systems, with a low mass main sequence turnoff, that are significantly brighter (0.4 to 1.0 magnitude) than the RR Lyrae variables in the same system. They do have similar periods and effective temperatures. In dwarf spheroidal systems such as Draco, Leo II, Sculptor and Ursae Major, they are quite common, but they are rare in globular clusters. Only one is well known in the globular cluster NGC 5466 (Zinn and Dahn, 1976), but there are other possible candidates in M15 and omega Centauri. Similar objects are found in the SMC, but none are seen in the LMC. DOE

N86-29742# Los Alamos National Lab., N. Mex.
COMPARISON OF THEORETICAL AND OBSERVED SODIUM D2 LINE PROFILES FOR TWO LATE-TYPE DWARFS
D. C. Boice 1985 4 p Presented at the 4th Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun, Santa Fe, N. Mex., 16 Oct. 1985
(Contract W-7405-eng-36)
(DE86-003678; LA-UR-85-3983; CONF-8510265-1) Avail: NTIS HC A02/MF A01

For many years the Ca II H and K lines and the Mg II h and k lines have been used as chromospheric diagnostics to compute semi-empirical model chromospheres for late-type stars. However, since Johnson (1964) showed that the Na I D1 and D2 lines are collision-controlled in the atmospheres of late-type stars, only a few researchers have studied the detailed NLTE formation of these lines. Such a study for the two stars, EQ Vir (dK5e) and Gliese 616.2 (dm1.5e) is summarized. A detailed discussion of this research can be found in Boice (1985). High resolution observations of the D lines for these two stars have been obtained at the KPNO 4-meter Mayall telescope using the echelle spectrometer with a resolution of 0.158A at D2. DOE

N86-29743# Royal Greenwich Observatory, Herstmonceux (England).
TELESCOPES, INSTRUMENTS, RESEARCH, AND SERVICES: OCTOBER 1, 1980 - SEPTEMBER 30, 1985
Paul Murdin, ed. and Jasper Wall, ed. 1985 129 p
(ESA-86-97102) Avail: NTIS HC A07/MF A01

Research in galaxies; extragalactic region; black holes; star formation; star clusters; astrometry; and space geodesy is summarized. Astronomical telescopes; satellite laser ranging; the HIPPARCOS mission; and services provided to scientists and the public by the Royal Greenwich Observatory are described. ESA

90 ASTROPHYSICS

Includes cosmology; and interstellar and interplanetary gases and dust.

N86-29744*# Scripps Institution of Oceanography, La Jolla, Calif. Geological Research Div.
CARBONACEOUS CHONDRITES: EARLY IRRADIATION AND Pu-244 FISSION RECORDS Final Technical Report, 1 Feb. 1975 - 31 Jan. 1983
J. D. Macdougall 1983 8 p refs
(Grant NsG-7121)
(NASA-CR-177288; NAS 1.26:177288) Avail: NTIS HC A02/MF A01 CSCL 03B

The carbonaceous meteorites were studied. The studies which were conducted have evolved from investigations of early irradiation to mineralogic and petrologic studies of refractory inclusions and to an examination of the time scales of alteration processes on the parent bodies. The attached listing of papers and abstracts provide the details. Author

N86-29745*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL STUDIES OF COLLAPSING INTERSTELLAR CLOUDS Final Technical Report
Peter H. Bodenheimer (Lick Observatory, Santa Cruz, Calif.), Karen R. Villere (California Univ., Santa Cruz.), and David C. Black 15 Feb. 1986 21 p
(Contract NCC2-269)

(NASA-TM-88771; NAS 1.15:88771) Avail: NTIS HC A02/MF A01 CSCL 03B

Numerical simulation of the structure and evolution of interstellar clouds was initiated. Steps were taken toward an integrated treatment of the dynamical, thermal, and chemical processes entering model calculations. A detailed study was made of radiative transfer in molecular lines to allow model predictions to be tested against empirical data. The calculations have successfully reproduced and explained several observed cloud properties, including abundances of complex molecular species and the apparent depletion of CO in dense cores. Author

N86-29746# Lick Observatory, Santa Cruz, Calif.
PHYSICS OF SUPERNOVAE
S. E. Woosley and T. A. Weaver (Lawrence Livermore National Lab., Calif.) 13 Dec. 1985 31 p Prepared in cooperation with Lawrence Livermore National Lab., CA.
(Contract W-7405-eng-48)
(DE86-005619; UCRL-93818) Avail: NTIS HC A03/MF A01

Presupernova models of massive stars are presented and their explosion by delayed neutrino transport examined. A new form of long duration Type II supernova model is also explored based upon repeated encounter with the electron-positron pair instability in stars heavier than about 60 M sub solar. Carbon deflagration in white dwarfs is discussed as the probable explanation of Type I supernovae and special attention is paid to the physical processes whereby a nuclear flame propagates through degenerate carbon. DOE

N86-29747# Lawrence Livermore National Lab., Calif.
GAMMA RAY BURSTS AND NEUTRON STAR STRUCTURE
E. Liang Jun. 1985 7 p Presented at the 4th Marcel Grossmann Meeting on General Relativity, Rome, Italy, 17 Jun. 1985
(Contract W-7405-eng-48)
(DE86-002140; UCRL-93514; CONF-8506208-1) Avail: NTIS HC A02/MF A01

New results are summarized on neutron star structure and vibrational frequencies using the redshift database derived from gamma ray burst annihilation lines. DOE

N86-29748# Los Alamos National Lab., N. Mex.
CHEMICO-PHYSICAL MODELS OF COMETARY ATMOSPHERES
W. F. Huebner, J. J. Keady, D. C. Boice, H. U. Schmidt, and R. Wegmann 1985 10 p Presented at the International Astronomical Union Symposium, Goa, India, 3 Dec. 1985 Prepared in cooperation with Max-Planck-Institut fuer Physik und Astrophysik, Garching, West Germany
(Contract W-7405-eng-36)
(DE86-006031; LA-UR-86-268; CONF-851262-2) Avail: NTIS HC A02/MF A01

Sublimation (vaporization) of the icy component of a cometary nucleus determines the initial composition of the coma gas as it streams outward and escapes. Photolytic reactions in the inner coma, escape of fast, light species such as atomic and molecular hydrogen, and solar wind interaction in the outer coma alter the chemical composition and the physical nature of the coma gas. Models that describe these interactions must include: (1) chemical kinetics; (2) coma energy balance; (3) multifluid flow for the rapidly escaping light components, the heavier bulk fluid, and the plasma with separate temperatures for electrons and the remainder of the gas; (4) transition from a collision dominated inner region to free molecular flow of neutrals in the outer region; (5) pickup of cometary ions by the solar wind; (6) counter and cross streaming of neutrals with respect to the plasma which outside of the contact surface also contains solar wind ions; and (7) magnetic fields carried by the solar wind. Progress on such models is described and results including velocity, temperature, and number density profiles for important chemical species are presented and compared with observations. DOE

N86-29749# Los Alamos National Lab., N. Mex.
COMPUTATION OF MOLECULAR ABUNDANCES OF OPACITIES IN THE ATMOSPHERES OF LATE-TYPE STARS
C. M. Sharp 1985 3 p Presented at the International Astronomical Union Symposium, Goa, India, 3 Dec. 1985
(Contract W-7405-eng-36)
(DE86-006038; LA-UR-86-348; CONF-851262-1) Avail: NTIS HC A02/MF A01

The presence of molecules in cool stellar atmospheres can dominate the opacity. Some calculations have been done with a carbon-rich mixture of C/O = 2, and the molecules C2, CN, HCN and C2H2 are major sources of opacity due to their large abundances. New calculations with HCN and C2H2 show they can be important. DOE

N86-29750# Los Alamos National Lab., N. Mex.
PG1159 VARIABLES
A. N. Cox 1985 9 p Presented at the International Astronomical Union Meeting, New Delhi, India, 17 Nov. 1985
(Contract W-7405-eng-36)
(DE86-006041; LA-UR-86-379; CONF-8511151-1) Avail: NTIS HC A02/MF A01

A 0.6 solar mass model is discussed that has a temperature ranging from 100,000 K for its surface effective temperature to a maximum of almost 200 million K, and then a decrease to about 85 million K at the center. This temperature inversion is caused by strong neutrino losses at the high central densities. These internal densities range from 0.000001 to one million K, g/cm(3) from the surface to the center. For luminosities considerably lower than the 1.075 x 10 to the 35th power erg/sec for this model, the central temperature inversion disappears and the central density grows larger. For the PG1159 class of stars however, there is always this inversion. DOE

N86-29751# Chicago Univ., Ill.
COSMOLOGIST'S TOUR THROUGH THE NEW PARTICLE ZOO (CANDY SHOP)
M. S. Turner Jan. 1986 40 p Presented at the International Astronomical Union Meeting, Princeton, N.J., 24 Jun. 1985 Prepared in cooperation with Fermi National Accelerator Lab., Batavia, Ill.
(Contract DE-AC02-76CH-03000)
(DE86-007889; FNAL/C-86/18-A; CONF-8506199-3) Avail: NTIS HC A03/MF A01

Recent developments in elementary particle physics have led to a renaissance in cosmology and in the study of structure formation. Already, the study of the very early (t less than or equal to 0.01 sec) history of the Universe has provided valuable hints as to the initial data for the structure formation problem - the nature and origin of the primeval density inhomogeneities, the quantity and composition of matter in the Universe today, and numerous candidates for the constituents of the ubiquitious dark matter. I review the multitude of WIMP candidates for the dark matter provided by modern particle physics theories, putting them into context by briefly discussing the theories which predict them. I also review their various birth sites and birth processes in the early Universe. At present the most promising candidates seem to be a 30 or so eV neutrino, a few GeV photino, or the invisible axion (weighing in at about 0.00001 eV), with a planck mass monopole, quark nuggets, and shadow matter as the leading dark horse candidates. I also mention some ve ry exotic possibilities - unstable WIMPs, cosmic strings, and even the possibility of a relic cosmological term. DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design see *18 Spacecraft Design Testing, and Performance.* For space stations see *15 Launch Vehicles and Space Vehicles.*

N86-29752*# National Aeronautics and Space Administration, Washington, D.C.

VERTICAL THERMAL STRUCTURE OF THE VENUS ATMOSPHERE FROM TEMPERATURE AND PRESSURE MEASUREMENTS

V. M. Linkin, Zh. Blamon, A. P. Lipatov, S. I. Devyatkin, A. V. Dyachkov, S. I. Ignatova, V. V. Kerzhanovich, K. Malyk, V. I. Stadny, Ya. V. Sanotskiy et al May 1986 9 p Transl. into ENGLISH from Pismma v AZh (USSR), v. 12, no. 2, 1986 p 100-105 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88420; NAS 1.15:88420) Avail: NTIS HC A02/MF A01 CSCL 03B

Accurate temperature and pressure measurements were made on the Vega-2 lander during its entire descent. The temperature and pressure at the surface were 733 K and 89.3 bar, respectivelv. A strong temperature inversion was found in the upper troposphere. Several layers with differing static stability were visible in the atmospheric structure. Author

N86-29753*# National Aeronautics and Space Administration, Washington, D.C.

CHEMICAL ANALYSIS OF AEROSOL IN THE VENUSIAN CLOUD LAYER BY REACTION GAS CHROMATOGRAPHY ON BOARD THE VEGA LANDERS

B. G. Gelman, Yu. V. Drozdov, V. V. Melnikov, V. A. Rotin, V. N. Khokhlov, V. B. Bondarev, G. G. Dolnikov, A. V. Dyachkov, D. F. Nenarokov, L. M. Mukhin et al May 1986 8 p Transl. into ENGLISH from Pisma v AZh (USSR), v. 12, no. 2, 1986 p 106-109 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88421; NAS 1.15:88421) Avail: NTIS HC A02/MF A01 CSCL 03B

The experiment on sulfuric acid aerosol determination in the Venusian cloud layer on board the Vega landers is described. An average content of sulfuric acid of approximately 1 mg/cu m was found for the samples taken from the atmosphere at heights from 63 to 48 km and analyzed with the SIGMA-3 chromatograph. Sulfur dioxide (SO_2) was revealed in the gaseous sample at the height of 48 km. From the experimental results and blank run measurements, a suggestion is made that the Venusian cloud layer aerosol consists of more complicated particles than the sulfuric acid water solution does. Author

N86-29754*# National Aeronautics and Space Administration, Washington, D.C.

MEASUREMENTS OF THE COMPOSITION OF AEROSOL COMPONENT OF VENUSIAN ATMOSPHERE WITH VEGA 1 LANDER, PRELIMINARY DATA

Yu. A. Surkov, V. F. Ivanova, A. N. Pudov, V. P. Volkov, E. P. Sheretov, B. I. Kolotilin, M. P. Safonov, R. Thomas, J. Lespagnol, A. Hauser et al May 1986 8 p Transl. into ENGLISH from Pisma v AZh (USSR), v. 12, no. 2, 1986 p 110-113 Transl. by Kanner (Leo) Associates, Redwood City, Calif.
(Contract NASw-4005)
(NASA-TM-88422; NAS 1.15:88422) Avail: NTIS HC A02/MF A01 CSCL 03B

Preliminary investigation of mass spectra of gaseous products of pyrolyzed Venusian cloud particles collected and analyzed by the complex device of mass-spectrometer and collector pyrolyzer on board Vega 1 lander revealed the presence of heavy particles in the upper cloud layer. Based on 64 amu peak (SO_2+), an estimate of the lower limit of the sulfuric acid aerosol content at the 62 to 54 km heights of approximately 2.0 mg/cu m is obtained. A chlorine line (35 and 37 amu) is also present in the mass spectrum with a lower limit of the chlorine concentration of approximately 0.3 mg/ cu m. Author

N86-29302*# National Center for Atmospheric Research, Boulder, Colo.

APPLICATIONS OF A VENUS THERMOSPHERIC CIRCULATION MODEL

S. W. Bougher, R. E. Dickinson, E. C. Ridley, and R. G. Roble *In* NASA. Goddard Space Flight Center Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 1-21 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 03B

N86-29335*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

A THREE DIMENSIONAL MODEL OF THE VENUSIAN THERMOSPHERE WITH SUPERROTATION

D. R. Stevens-Rayburn (Applied Research Corp., Landover, Md.), H. G. Mayr, and I. Harris *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 445-450 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 03B

N86-29337*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

OBSERVATIONS OF COMPOSITION FROM PIONEER VENUS

H. A. Taylor, Jr. *In its* Thermosphere Dynamics Workshop, Volume 2 Jun. 1986 p 463-465 (For primary document see N86-29301 20-42)
Avail: NTIS HC A20/MF A01 CSCL 03B

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

N86-29755# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

RAPID SPECTRAL AND FLUX TIME VARIATIONS IN A SOLAR-BURST OBSERVED AT VARIOUS DM-MM WAVE LENGTHS AND AT HARD X-RAYS

A. M. Zodi Vaz, P. Kaufmann, E. Correia, J. E. R. Costa, E. W. Cliver (Air Force Geophysics Lab., Hanscom AFB, Mass.), T. Takakura (Tokyo Univ. (Japan).), and K. F. Tapping (Herzberg Inst. of Astrophysics, Ottawa (Ontario).) Feb. 1986 15 p refs Presented at the SMM Topical Workshop on Rapid Fluctuations in Solar Flares, Lanham, Md., 29 Sep. - 4 Oct. 1985 Submitted for publication
(INPE-3811-PRE/897) Avail: NTIS HC A02/MF A01

A solar burst was observed with high sensitivity and time resolution at cm-mm wavelengths by two different radio observatories (Itapetinga and Algonquin), with high spectral time resolution at dm-mm wavelengths by patrol instruments (Sagamore Hill), and at hard X-rays (HXM-Hinotori). At the onset of the major burst time structure there was a rapid rise in the spectral turnover frequency (from 5 to 15 GHz), in about 10s, coincident to a reduction of the spectral index in the optically thin part of the spectrum. The burst maxima were not time coincident at the optically thin radio frequencies and at the different hard X-ray energy ranges. The profiles at higher radio frequencies exhibited better time coincidence to the higher energy X-rays. The hardest X-ray spectrum (-3) coincided with peak radio emission at the higher frequency (44 GHz). The event appear to be built up by a first major injection of softer particles followed by other injections of harder particles. Ultrafast time structures were identified as superimposed on the burst emission at the cm-mm high sensitivity data at X-rays, with predominant repetition rates ranging from 2.0 to 3.5 Hz. Author

N86-29756*# Alaska Univ., Fairbanks. Geophysical Inst.

A SIMULATION STUDY OF TWO MAJOR EVENTS IN THE HELIOSPHERE DURING THE PRESENT SUNSPOT CYCLE

S.-I. Akasofu, W. Fillius (California Univ., San Diego, La Jolla.), Wei SUN, C. Fry, and M. Dryer (National Oceanic and Atmospheric Administration, Boulder, Colo.) 1985 48 p
(Grant NAG2-153)
(NASA-CR-176943; NAS 1.26:176943) Avail: NTIS HC A03/MF A01 CSCL 03B

The two major disturbances in the heliosphere during the

present sunspot cycle, the event of June to August, 1982, and the event of April to June, 1978, are simulated by the method developed by Hakamada and Akasofu (1982). Specifically, an attempt was made to simulate the effects of six major flares from three active regions in June and July, 1982, and April and May, 1978. A comparison of the results with the solar wind observations at Pioneer 12 (approximately 0.8 au), ISEE-3 (approximately 1 au), Pioneer 11 (approximately 7 to 13 au) and Pioneer 10 (approximately 16 to 28 au) suggests that some major flares occurred behind the disk of the sun during the two periods. The method provides qualitatively some information as to how such a series of intense solar flares can greatly disturb both the inner and outer heliospheres. A long lasting effect on cosmic rays is discussed in conjunction with the disturbed heliosphere. Author

N86-29757# Midwest Research Inst., Golden, Colo. Solar Energy Research Inst.

COMPARISONS OF MODELED AND MEASURED SPECTRAL SOLAR IRRADIANCE DATA

C. J. Riordan Feb. 1986 55 p

(Contract DE-AC02-83CH-10093)

(DE86-004425; SERI/TR-215-2809) Avail: NTIS HC A04/MF A01

This report contains comparisons of modeled and measured spectral solar irradiance data made at the Solar Energy research Institute (SERI). The modeled data were generated using a simple, spectral solar irradiance model developed at SERI; measured data were obtained with LI-COR model LI-1800 portable spectroradiometers specially modified at SERI. This work is part of a continuing endeavor to verify spectral irradiance models and to generate spectral irradiance data for different locations and climates. DOE

N86-29758# Bern Univ. (Switzerland). Div. of Solar Observations.

BERNE SOLAR OBSERVATIONS FOR JANUARY-DECEMBER 1985

1986 14 p

(Rept-52; ESA-86-97070) Avail: NTIS HC A02/MF A01

The results of the standard measurements carried out at the solar observatory are presented. The measurements show start, maximum, duration, peak flux, and circular polarization at peak as a percentage of outstanding events. ESA

N86-29759# Consiglio Nazionale delle Ricerche, Frascati (Italy). Ist. di Fisico dello Spazio Interplanetario.

A MODEL FOR PROTON HEATING IN THE SOLAR WIND

H. A. Shah, L. Iess, and M. Dobrowolny Sep. 1985 38 p Sponsored by ICTP, Trieste

(IFSI-85-9; ESA-86-97093) Avail: NTIS HC A03/MF A01

Quasilinear theory is used to calculate the power dissipated via obliquely propagating Alfven waves to heat the solar wind protons. This shows good agreement with the power which needs to be supplied to the solar wind protons as deduced from Helios observations. A corresponding calculation is made to obtain the evolution of parallel proton temperature with increasing heliocentric distance. Theoretical results and those obtained from Helios data compare well, especially for the fast streams. ESA

N86-29760# National Oceanic and Atmospheric Administration, Boulder, Colo. World Data Center A for Solar-Terrestrial Physics.

SOLAR MAGNETIC FIELD, 1976 THROUGH 1985: AN ATLAS OF PHOTOSPHERIC MAGNETIC FIELD OBSERVATIONS AND COMPUTED CORONAL MAGNETIC FIELDS FROM THE JOHN M. WILCOX SOLAR OBSERVATORY AT SANFORD, 1976-1985

J. T. Hoeksema and P. H. Scherrer Jan. 1986 370 p

(PB86-183522; UAG-94) Avail: NTIS HC A16/MF A01 CSCL 03B

Daily magnetogram observations of the large-scale photospheric magnetic field have been made at the John M. Wilcox Solar Observatory at Stanford since May of 1976. These measurements provide a homogeneous record of the changing solar field through most of Solar Cycle 21. Using the photospheric data, the configuration of the coronal and heliospheric fields can be calculated using a Potential Field - Source Surface model. This provides a 3-dimensional picture of the heliospheric field evolution during the solar cycle. In the report the authors present the complete set of synoptic charts of the measured photospheric magnetic field, the computed field at the source surface, and the coefficients of the multipole expansion of the coronal field. The general underlying structure of the solar and helispheric fields, which determine the environment for solar terrestrial relations and provide the context within which solar activity related events occur, can be approximated from these data. GRA

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics*.

N86-29761# California Univ., Berkeley. Lawrence Berkeley Lab.

REVIEW OF COSMIC BACKGROUND RADIATION SPECTRUM MEASUREMENTS: LIMITS ON DISTORTIONS, ENERGY RELEASE AND COSMOLOGICAL PROCESSES

G. F. Smoot Jan. 1986 12 p Presented at the International Astronomical Union Meeting, New Delhi, India, 17 Nov. 1985

(Contract DE-AC03-76SF-00098)

(DE86-007487; LBL-20942; CONF-8511151-2) Avail: NTIS HC A02/MF A01

This paper reviews the three major cosmic microwave background radiation (CMBR) spectrum measurement programs conducted and published since the last (XVII) IAU General Assembly. The results are consistent with a Planckian spectrum with temperature 2.72 +- 0.03 K spanning a wavelength range of 0.1 to 12 cm. Limits on possible distortions and implications are outlined. Ongoing and future measurements are discussed. DOE

99 GENERAL

No abstracts in this category.